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A M P H I P A C I F I C A

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DEDICATION

The Journal AMPHIPACIFICA is dedicated to the promotion of systematic biology and to the conservation of Earth's natural resources.

Cover design: Adapted from the title page of S. J. Holmes (1904). "Amphipod Crustaceans of the Expedition."
Harriman Alaska Expedition, pages 233-244.

Editorial Commentary . . .

The second number of volume II of Amphipacifica has appeared -- at long last! It is slightly larger than previous issues, mainly because of the size of its two major revisionary inclusions. Having laboured through the long process of putting these papers together, the authors fully understand why colleagues may have so long resisted the urge (let alone the need!) to revise the species-rich amphipod families Melitidae and Oedicerotidae. These taxa represent two of the larger and more difficult challenges of current amphipod systematics. However, the present analyses were made possible by utilizing extensive collections of coastal shelf amphipods from the little studied eastern North Pacific region, obtained mainly during National Museum of Canada surveys, 1955-1980. Hopefully, the results will be applicable, at least in part, wherever these family groups may be encountered world-wide.

To date, the readership has been generally positive in regard to the scientific contents of Amphipacifica. Some colleagues plan to submit manuscripts, but large ones take time to prepare. Initial subscriptions have mostly been renewed and new subscriptions continue to "trickle in". However, some colleagues have expressed concern about the dominance of amphipod crustaceans in the subject matter, and the frequency of authorship and/or co-authorship by E. L. Bousfield in the papers that have appeared to date.

Some readers may not be aware of historical and logistical factors leading to the institution of this new journal. The large amphipod studies are part of a long-term program on the fauna of the North Pacific coastal marine region commenced more than 40 years ago at the National Museum in Ottawa. To date, this undertaking has involved nearly two dozen authors, artists, sorters, and curatorial workers, many of them contributors from outside Canada. Nearly 40 papers, covering about two-thirds of the regional superfamily groups, have already been published or are in preparation. However, during the past ten years, the closing down of research publications at the CMN in Ottawa, and more recently, at the RBCM here in Victoria, left little alternative but to conduct a "salvage operation" on the partly written texts, and on their costly, mostly previously prepared illustrations. With post-career options running out, private "desk-top" publication seemed an economically feasible and expedient answer to the problem, hence Amphipacifica. However, little previous experience and few resources have compounded the problem of first-class editing of a complex scientific journal, over and above the difficulty of collating the research papers themselves. Hopefully the studies will be evaluated on their content of new taxonomic information and new scientific ideas, rather than on the frequency of typos and misplaced punctuation, regrettable as that may be. We can only strive toward a steady mechanical improvement of each issue.

On a related topic, many colleagues feel that the plight of systematic biology in this country is not healthy and is apparently declining, at least in the short term. Universities have largely dispensed with the teaching of alpha-level whole-organism biology and few research museums in Canada remain fully functional. Currently, the Canadian Museum of Nature and the Royal B. C. Museum provivde only limited collection-based service while buildings and research facilities are under renovation and/or construction. At the Holly Lane curatorial facilites in Ottawa, collections are accessible for only brief periods each week, because ventilation in the building, where fluid-preserved collections are housed, is deemed inadequate.

In an attempt to put a more positive spin on the situation, the CMN published, in CSZ "Bulletin" 27(1), a "Directory of Zoosystematists" that lists taxonomic and curatorial disciplines covered by the present staff and research associates. One does not wish to minimize the near-heroic struggles of present staff to conduct systematic research in the face of drastically restricted budgets, frozen salaries, and bureaucratized working systems. However, those who may have served in such institutions, just 15-20 years ago, may recall , perhaps wistfully, how much larger had been the full-time staff and the taxonomic coverage, especially in the vertebrate disciplines. The growth of collections was then directed by the scientist-curators, supported by fully funded field seasons, in all parts of the country. Research results were quickly and responsibly communicated through widely respected (refereed) in-house journals. Hopefully, a return to fully funded systematic research will be a feature of the new facility of the CMN now under construction at an environmentally "sensitive" location in Aylmer, Quebec province.

The decision to publish a special supplementary issue of Amphipacifica last April, for taxonomic treatment of the sea serpent *Cadborosaurus willsi*, has elicited considerable reaction, both pro and con, from professional and amateur naturalists alike. Interest was perhaps more widely stimulated by NBC 's "Unsolved Mysteries" televised production last December, with a re-run in March of this year. The 10-minute "short" featured an animated 3-D reconstruction of the animal

About our Authors . . .

Andrée Chevrier is a new contributor to the North Pacific monographic series in this issue of Amphipacifica. Andrée obtained her MSc in biological sciences at Université de Montréal, Québec, in 1990, under the direction of Dr. Pierre Brunel. Her thesis analysed the structure of the suprabenthic shelf community of gammaridean amphipods in the Bay of Fundy in comparison with those of the Gulf of St. Lawrence. .She is currently employed with Environment Canada in a marine environmental production program, and as a consultant in benthic ecology and taxonomy. Recent undertakings include co-ordinating of development of monitoring guidelines for ocean disposal sites, implementing sediment quality guidelines in marine assessments, and participating in development of a standard method for biological testing, using species of polychaetes worms.

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that was based on the archival lectotype photographs, with technical input from a Canadian "elasmosaur" paleobiologist. The life-like "free-swimming" model is probably the closest that nearly all viewers will ever come to this rarely glimpsed deep-demersal reptilian species. To date, independent reviews of the research paper, and the popular booket, have been cautiously favourable but some have been extensively critical. While conceding the conservational advantage of studying a possibly rare and endangered species from a "phototype" standpoint, taxonomic "purists" tend not to accept the legitimacy of photographs as holotypes or lectotypes. Invariably they insist on much "harder" evidence such as a "specimen in hand", without providing any advice on how one might obtain a specimen "in the wild" that may be 20 metres long, weigh three tons, and propels itself, at the surface, at speeds of well over 30 m. p. h. In the meantime, the animal continues to be sighted, predictably, in waters around Victoria.

In closing, we note with sadnesss the passing, last August, 1995, of our long time friend and research colleague Dr. Thomas E. Bowman. Tom served for more than 30 years as a curator of Crustacea at the United States National Museum in Washington, D. C. Although his primary research interests centred on isopod and copepod systematics, Tom was one of the most versatile of professional carcinologists. He had published, solo or in co-authorship, major works on half a dozen different crustacean groups, including the amphipods, and had become a world "authority" on the oceanic hyperiid amphipods. In recognizing his enormous contribution to Carcinology and the help he gave, unstintingly, to other workers, Norma Jarrett and I have herewith named the melitid amphipod, *Megamoera bowmani*, in his honour. We extend our deepest sympathy to his wife, Mary Jo.

THE AMPHIPOD SUPERFAMILY HADZIOIDEA ON THE PACIFIC COAST OF NORTH AMERICA: FAMILY MELITIDAE. PART I. THE *MELITA* GROUP: SYSTEMATICS AND DISTRIBUTIONAL ECOLOGY.

by Norma E. Jarrett[1] & E. L. Bousfield[2]

ABSTRACT

In the North American Pacific coastal marine region, from the Bering Sea to Central California, species of the *Melita* group of gammaridean amphipod crustaceans (family Melitidae) had previously been assigned to the genera *Melita* Leach, 1814 (revised Karaman, 1981), *Abludomelita* Karaman, 1981, and *Dulichiella* Stout, 1912. Within genus *Melita* (type species - *M. palmata* Montagu, 1814), the following taxa from the North American Pacific coast are here newly described or redescribed, and keyed: *Melita oregonensis* J. L. Barnard, 1954; ***Melita* alaskensis,** new species; *Melita sulca* (Stout, 1913) and *Melitida nitida* Smith, 1873. The following taxa are removed from the concept of genus *Abludomelita* Karaman, 1981 sens. str.: ***Megamoera*** Bate, 1862, containing type species *Megamoera dentata* (Kroyer 1842); *M. subtener* (Stimpson, 1964); ***M. bowmani***, new species; ***M rafiae***, new species; *M. mikulitschae* (Gurjanova, 1953); *M. kodiakensis* (J. L. Barnard, 1964); *M. amoena* (Hansen, 1888); ***M. unimaki***, new species; ***M. glacialis***, new species and ***M. borealis***, new species; ***Quasimelita***, new genus, with type species *Quasimelita quadrispinosa* (Vosseler, 1889); *Q. formosa* (Murdoch, 1885) and *Q. abyssorum* (Stephensen, 1944); ***Desdimelita***, new genus, with type species *D. desdichada* (J. L. Barnard, 1962); *D. californica* (Alderman, 1936); ***D. microdentata***, new species; ***D. microphthalma***, new species and ***D. barnardi***, new species. *Melitoides* Gurjanova, 1934, with type species *M. makarovi* Gurjanova, 1934, is here recognized as part of the *Abludomelita* complex of genera. *Melita valida* Shoemaker, 1955, from Pt. Barrow Alaska, is provisionally assigned to *Melitoides*. The genus *Abludomelita* Karaman, 1981, is now restricted to a complex of Mediterranean and Indo-Pacific species (type species - *A. gladiosa* (Bate, 1862)) of which *A. denticulata* (Nagata, 1965), *A. japonica* (Nagata, 1965), *A. unamoena* (Hirayama, 1987), *A. somovae* (Bulycheva 1952) and *A. sexstachya* (Gamo, 1977) are aberrant eastern Asiatic representatives. *Abludomelita* is considered ancestral to the warm temperate genus *Dulichiella* Stout, 1912, represented on the North American coast by the type species *Dulichiella spinosa* Stout, 1912, and on the Asiatic coast by two apparently unnamed species.

Biogeographically, of the 40 species within the *Abludomelita* and *Melita* generic complexes here recorded from the North Pacific region, the North American and Asiatic species are about equal in number, but very different in taxonomic composition. Only 3 species are common to the two coasts, and these only in the Bering Sea region. Thus, the subarctic-boreal *Abludomelita* complex is represented by 21 species along North American shores, including 9 species of *Megamoera*, 6 species of *Desdimelita*, but none of *Abludomelita*. By contrast, only 9 species of this complex occur along the Asiatic coast, including 5 species of *Abludomelita*, 2 species of *Megamoera*, but none of *Desdimelita*. Also by contrast, at least twelve species of the tropical and warm temperate genus *Melita* are known from the Asiatic coast, but only four species from North American shores. Several mainly Indo-Pacific generic complexes within the *Melita* group, including the *Eriopisa, Eriopisella, Carnarimelita* and *Rotomelita* subgroups, penetrate southern fringes of the North Pacific region, including the Hawaiian islands, but are not treated in detail here.

Behaviourally and ecologically, the animals are free-swimming and free-crawling omnivores, mainly of under-rock habitats, at intertidal to shallow-sublittoral depths, but a few are bathyal to abyssal. Diminution of setation of mouthparts, especially the facial setae of the inner plate of maxilla 2, and concomitant enlargement of gnathopod 2, especially among deeper water species of the *Abludomelita* complex, may correlate with differences in feeding and life styles. Sexual dimorphism of gnathopod 1 and coxa 6, correlated elsewhere with a unique form of pre-amplexing "carrying" behaviour, attains its highest level of specialization in the genus *Melita*. Sexual dimorphism of gnathopod 2 that may be correlated with reproductively significant percussive sound production, is pronounced in *Abludomelita*, and most specialized in *Dulichiella*.

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INTRODUCTION

The *Melita* group within amphipod family Melitidae is a relatively recent taxonomic concept that was first formally diagnosed as "melitids" by Barnard & Barnard (1983). However, their concept included a number of generic groups such as (1)*Eriopisa, Victoriopisa, Maleriops*, and (2)*Paraniphargus, Psammogammarus* and *Galapsiellus* some of which appear more closely related to other generic groups within the family (p. 5). The concept of "*Melita* group" is here restricted to the genera *Melita, Dulichiella, Rotomelita, Nainola, Tegano, Anchialella, Josephella, Eriopisa, Eriopisella,* and other closely related genera described since that time.

The genus *Melita* was first described by Leach (1814), with *Cancer palmatus* Montague, 1804, as its type species. In the major compendium of Stebbing (1906), this generic name was applied to gammaroidean animals with a dispariramous or markedly inaequiramous uropod 3 and markedly unequal, sexually dimorphic gnathopods 1 & 2. Following suppression of the genus *Megamoera* Bate (1862), having *M. dentata* Krøyer as its type species, and subsequent to several species synonymies, the genus *Melita* had become restricted to 12 formally recognized species. In 1912, Stout proposed *Dulichiella* for her new Californian melitid species, *D. spinosa* , and in 1913 erected the genus *Calliniphargus* , for her newly described *C. sulca* . However, these names were later submerged within the genus *Melita* by Barnard (1969a) who then recognized 45 world species.

In 1977, the junior author (ELB) revised and formalized earlier attempts (e.g., Melitidae Bousfield, 1973) to bring classificatory order into the very large and unwieldy family taxon then known popularly as "good old Gammaridae". Superfamily Gammaroidea (and several endemic families) were proposed for *Gammarus*-like animals having somewhat similar-sized, usually sexually dimorphic and pre-amplexing gnathopods 1 & 2, and occurring mainly epigeically in fresh waters of the northern hemisphere. Superfamily Melitoidea (now Hadzioidea) was erected to encompass a revised and restricted family Melitidae (e.g., *Melita- and Maera*-like genera, having lower lips with distinct inner lobes, and occurring mainly epigeically in marine habitats) and family Hadziidae (e.g., hadziid, weckeliid, and grossly similar genera, lacking inner lobes, and mainly hypogean in brackish and fresh water habitats). As the splitting of unwieldy larger amphipod taxa rapidly became a more realistic nomenclatural trend, Barnard & Barnard (1983) recognized the monotypic genera *Dulichiella* Stout, 1912; *Melitoides* Gurjanova, 1934; *Rotomelita* Barnard, 1977; *Anchialella* Barnard, 1979, *Nainaloa* Karaman & Barnard, 1979; and *Tegano* Karaman & Barnard, 1982. Nonetheless, the genus *Melita* Leach per se had by then expanded to 60 recognized world species.

In 1981, Gordan Karaman proposed a major subdivision of the genus into *Melita,* based on the nominate type species, *M. palmata* (Montagu, 1804), and *Abludomelita*,new genus, with the Mediterranean species *A. obtusata* (Montagu, 1813) as its type. Karaman defined the genus *Abludomelita*, encompassing 25 world species, as follows: maxilla 1, inner plate triangular, inner margin setose; maxilla 2, inner plate with dorsal (facial) oblique row of setae; uropod 3, outer ramus 2-segmented. The genus *Melita,* encompassing 27 recognized species, was defined as follows: maxilla 1, inner plate triangular, with a row of distomarginal setae; maxilla 2, inner plate lacking dorsal oblique row of setae; uropod 3, outer ramus consisting of one segment only. Karaman (loc. cit.) also more narrowly defined the genus *Dulichiella*, with 11 species, as having: maxilla 1, inner plate narrowly conical, apex with only 1-2 plumose setae; maxilla 2, inner plate with oblique row of dorsal setae; left and right gnathopod 2 (male) unequal in size, with distolateral corner of propod produced, and dactyl strong; uropod 3, outer ramus 2-segmented.

Since that time, however, Karaman's revision has come under the close scrutiny of several authors (e.g., Zeidler, 1989; Yamato, 1990, etc.). Karaman's diagnostic criteria appear not correctly applicable to some species he included within the pertinent genera. Several other taxonomic character states, more conspicuous and possibly more phyletically significant, were deemed utilizable for the groups concerned. The subsequent erection of several new melitid genera (e.g. *Josephella* Stock, 1984; *Allomelita* Stock, 1984; *Quadrus* Karaman, 1984; *Carnarimelita* Bousfield, 1990), has further increased the need for expanded character-state consideration in melitoidean generic diagnoses. Finally, recent examination of a wealth of new species, both by Japanese workers in materials from the western North Pacific region (e.g. especially by Hirayama, 1987; Yamato 1988, 1990), and in materials from eastern north Pacific region here demonstrated, has necessitated a major new look at the classificatory status of the *Melita* group of species. It seems therefore that the *Melita* complex consists of *Melita*, sens. str. and taxonomically "aberrant" inclusives, *Abludomelita* and its subdivisions, *Dulichiella* , and other melitid genera whose relationships have yet to be more precisely clarified.

Investigations on the North American Pacific melitid group commenced more than a century ago with W. Stimpson's accounts (1856, 1864) of amphipods from California and survey material obtained by the Puget Sound Boundary Commission, and Walker's (1898) record of *Melita dentata* from Puget Sound. This work had followed J. D. Dana's (1852) account of melitids among crustaceans of Hawaii, all summarized by Stebbing (1906), including species since removed to other amphipod families. In the early 20th century, studies on the melitid group of California were initiated by Vinnie R. Stout (1912, 1913) and A. L. Alderman (1936). In the years following WWII, however, enormous impetus to the study of the regional melitid group was provided by J. L. Barnard (1952 through 1983). Arctic Alaskan records were summarized by C. R. Shoemaker (1955), and records of melitids introduced through commerce to western N. America were collated by J. W. Chapman (1988). Melitid records from British Columbia were summarized notably by G. H. Wailes (1931) and W. C. Aust-

in (1985). Records of common melitid species were utilized in keyed and illustrated popular guides by E. F. Ricketts & J. Calvin (1968), by J. L. Barnard (1975), and by C. P. Staude (1987).

In the western North Pacific region, studies on the melitid group were initiated, much more recently, by Eupraxie F. Gurjanova (1934, 1936, 1938). Publications on the far eastern fauna of the USSR continued after WWII with Gurjanova's major compendium (1951) and shorter papers (e.g., 1965), with A. I. Bulycheva (1952, 1955) and with the regional faunal lists of others (e.g., V. L. Kudryaschov, 1972). Serious taxonomic work on the melitid fauna of Japanese waters commenced with the studies of M. Ueno (1940) and K. Stephensen (1944), followed by that of K. Nagata (1960, 1965). During recent years, many new regional records and much detailed work on this group have been published by A. Hirayama (1978, 1986, 1987), Hirayama & T. Kikuchi (1979), S. Gamo (1977), Gordan Karaman (1979), and S. Yamato (1985, 1987, 1988, 1990). The present writers have touched only on the principal studies; these and listings of species from Japanese waters by several others, have been ably summarized by S. Ishimaru (1994).

The present study treats the systematics and distributional ecology of *Melita* group amphipods that occur in the North American Pacific coastal marine region, from western Alaska to central California, and relates this fauna to that of the adjacent western North Pacific and world-wide marine regions.

ACKNOWLEDGMENTS.

The authors are grateful to several agencies and colleagues who contributed material and helpful commentary to the present study. For assistance in the field we again express our gratitude to marine agencies and colleagues acknowledged in previously published station lists (Bousfield (ELB), 1958, 1963, 1968; Bousfield & McAllister, 1962; Bousfield & Jarrett, 1981). We are particularly grateful for material from the Bering Sea region provided by Dr. Peter Slattery, Moss Landing, California, from the outer Aleutian Islands by Dr. C. E. O'Clair, Auk Bay, Alaska, and from Swanson Bay on the north-central coast of British Columbia provided by Dr. Colin Levings, Fisheries & Oceans, West Vancouver, B. C. The study has much benefited from the curatorial and research advisory input, over the years, of CMN colleagues E. A. Hendrycks, Kathleen E. Conlan, and Fahmida Rafi. Philosophical input to preparation of the manuscript and figures was provided at various times and stages by Drs. C. P. Staude, Friday Harbor, WA; J. H. Stock, Institute fur Taxonomic Research, The Netherlands; Dr. Shigeyuki Yamato, Hiroshima University, Japan; and the late Dr. J. L. (Jerry) Barnard, Smithsonian Institution, Washington, D. C. Susan Laurie-Bourque, Hull, Quebec, very capably prepared the original line illustrations accompanying the text, and Marjorie Bousfield, Montreal, Quebec, provided translations of pertinent Russian literature.

SYSTEMATICS

Family Melitidae Bousfield

Melitidae Bousfield, 1973: 61.—Bousfield, 1977: 299 (revised).—Bousfield, 1982: 281.—Barents, 1983: 103.—Lowry & Fenwick, 1983: 201.—Barnard & Karaman, 1991: 545 (part).—Ishimaru, 1994: 49.
"Melitids" Barnard & Barnard, 1983: 662 (part).

Type genus. *Melita* Leach, 1814.

Recent Genera.

Melita group (includes *Melita* group of Barnard & Barnard, 1983): *Abludomelita* G. Karaman; *Allomelita* Stock; *Anchialella* J. L. Barnard; *Carnarimelita* Bousfield; *Confodiopisa* Karaman; *Desdimelita*, n. g. (p. 40); *Dulichiella* Stout; *Eriopisa* Stebbing; *Eriopisella* Chevreux; *?Galapsiellus* J. L. Barnard; *Impertiopisa* Karaman; *Josephella* Stock; *Maleriopa* Barnard & Karaman; *Megamoera* Bate; *Melita* Leach; *Melitoides* Gurjanova; *Nainola* Barnard & Barnard; *Netamelita* J. L. Barnard; *Nippopisella* Stock; *?Paraniphargus* Tattersall; *Psammogammarus* S. Karaman; *Quadrus* G. Karaman; *Quasimelita*, n. g. (p. 36); *Roropisa* G. Karaman; *Rotomelita* J. L. Barnard; *Tegano* Barnard & Karaman; *Thalassostygius* Vonk; *Tunisopisa G. Karaman*; *Victoriopisa* Karaman & Barnard.

Maera group (includes the *Ceradocus, Paraceradocus* and *Maera* groups of Barnard & Barnard, 1983): *Anelasmopus* Oliveira, *Bathyceradocus* Pirlot; *Beaudettia* J. L. Barnard; *Ceradocus* Costa, *Ceradocoides* Nicholls, *Ceradomoera* Ledoyer; *Coxomaerella* G. Karaman; *Dumosus* Thomas & Barnard; *Elasmopoides* Stebbing; *Elasmopus* Costa; *Hoho* Lowry & Fenwick; *Ifalukia* J. L. Barnard; *Jerbarnia* Croker; *Lupimaera* Barnard & Karaman; *Maera* Leach; *Maerella* Chevreux; *Maeropsis* Chevreux; *Mallacoota* J. L. Barnard; *Metaceradocus* Chevreux; *Meximaera* J. L. Barnard; *Paraceradocus* Stebbing, *Parelasmopus* Stebbing, *Quadrivisio* Stebbing.

Other groups. Barnard & Barnard (1983) have summarized other groups within family Melitidae, viz., *Gammarella* group of *Gamarella* Bate and *Tabatzius* McKinney & Barnard; *Parapherusa* group of *Parapherusa* Stebbing; *Ceradocopsis* group of *Ceradocopsis* Schellenberg and *?Metaceradocoides* Birstein & Vinogradov.

Diagnosis. Peraeon generally smooth. Abdomen often mid-dorsally toothed or mucronate, rarely spinose or setose, or laterally toothed. Head, anterior lobe rounded, inferior antennal sinus reduced, often notch-like, rarely lacking entirely. Eye generally small, rounded, pigmented. Antenna 1, peduncles 1 & 2 elongate, 3 medium; accessory flagellum distinct, often short. Antenna 2 shorter than antenna 1, pedunclar segments 4-5 strong; flagellum relatively short.

Upper lip rounded or weakly notched below. Lower lip, inner lobes variously developed, distinct. Mandible: spine row strong; incisor and lacinia medium; palp often reduced

or weak, occasionally lacking, segments linear; molar usually with flake and plumose seta. Maxilla 1, inner plate triangular, inner margin and apex variously setose; outer plate with 9 (occ. 6-7) apical spines; left and right palps dissimilar. Maxilla 2, inner plate, facial row of setae variously developed or lacking. Maxilliped, palp strong, dactylate; inner plate usually with apical spines and inner marginal plumose setae; outer plate large, inner margin spinose.

Coxae 1-4 medium, hind margins often cuspate, 4th variously excavate behind. Gnathopods strongly sexually dimorphic, those of male pre-amplexing or agonistic in function. In males, gnathopods 1 & 2 markedly unequal in size; gnathopod 2, propod and dactyl large, powerful; carpus often short, hind lobe narrow, deep; gnathopods of female smaller, often slender and subsimilar, regularly subchelate. Peraeopods 3 & 4 variously unequal in size (4 smaller). Coxae 5-7 shallow, anterolobate. Peraeopod 5 variously smaller than subequal peraeopods 6 & 7; bases usually broad, lobate; distally segments occasionally reversed; dactyls small to medium, occasionally long.

Pleon 3, hind corner usually produced, acuminate. Pleopods normal, strong, occasionally sexually dimorphic. Uropods 1 & 2, rami usually linear, marginally and apically spinose; peduncle of uropod 1 with baso-facial and disto-lateral spines. Uropod 3 usually strong, inaequiramous; ramal margins spinose, weakly or not setose; terminal segment of outer ramus variously present, or lacking.

Telson lobes separate, occasionally fused basally; apices usually acute, spinose.

Coxal gill on peraeopod 6 smallest. Brood plates narrow, short, with few simple marginal setae.

Taxonomic and Distributional commentary. Members of family Melitidae occur mainly along tropical-warm-temperate littoral marine coastlines, but also not uncommonly in arctic-subarctic, antiboreal, and antarctic shelf regions. A few are hadal or abyssal. Others have penetrated coastal anchialine and fresh waters and resemble members of the Hadziidae in the reduced condition of their mouthparts, ambulatory appendages, and lack of pigmented eyes.

Members of family Melitidae are normally distinct from members of family Hadziidae in the well developed inner lobes of the lower lip. However, most melitids differ more conspicuously in their generally larger size, strongly pigmented eyes, and variously dorsally toothed pleosome and urosome. Moreover, melitid gnathopods are typically robust and strongly sexually dimorphic, and their peraeopods, uropods, and pleopods are typically more strongly spinose and/or powerfully developed. On the other hand sexually dimorphic pleopods occur in certain hadziids, lacking in melitids. Further study is needed to evaluate the precise applicability of these differences in all subgroups within both families.

The present study is confined to North Pacific regional members of the *Melita* group. The *Maera* group is to be treated in a subsequent study (Jarrett & Bousfield, in prep.). The present concept of the *Melita* group differs little from that of Barnard & Barnard (1983), but has been updated to accommodate recent inclusions. Thus, species of *Rotomelita* and *Carnarimelita* occur regionally only in Hawaii and/or elsewhere mainly in the Indo-Pacific region. Species of *Anchialella* and *Galapsiellus* are restricted to the Galapagos Islands, and the genera *Nainaloa, Tegano, Paraniphargus, Quadrus* and *Maleriopa* are western Indo-Pacific only, well outside the present study region.

Ishimaru (1994) listed *Gammarella* (=*Cottesloe*) *cyclodactyla* Hirayama, 1978, in the melitid fauna of Japanese waters. Barnard & Barnard (1983) consider the *Gammarella* (=*Nuuanu)* group, as well as *Dulzura* and *Liagoceradocus* to be hadzioidean because of their simple lower lips and/or deeply posterolobate coxae of peraeopods 5-7. Ishimaru correctly included *Jerbarnia ledoyeri* within the Melitidae (rather than the Melphidippidae) of Japan. It is here placed tentatively within the *Maera* group because of its aequiramous uropod 3. The phyletic relationships of both genera merit further study.

The *Eriopisella* group, including *Netamelita* J. L. Barnard, is considered a separate subgroup within family Melitidae by Barnard & Barnard (1983). *Netamelita cortada* J. L. Barnard occurs in California and a further species, unnamed by Nagata (1960), occurs in coastal waters of Japan. *Tagua* Lowry & Fenwick, 1983, with its monotypic species from Auckland and Snares Islands, is related to *Netamelita.* However, its posterolobate coxae, uropod 3 with relatively long, broad proximal segment and lacking a terminal segment, and relatively apomorphic mouthparts, appear at least convergently similar to those of *Eriopisa* within *Melita* group.

Melita group Barnard & Barnard, revised

Melita group Barnard & Barnard, 1983: 662 (part).

Type genus. *Melita* Leach, 1814: 403.

North Pacific Genera of the *Melita* group: *Abludomelita* G. Karaman; *Carnarimelita* Bousfield; *Desdimelita*, n. g. (p. 40); *Dulichiella* Stout; *Eriopisa* Stebbing; *Eriopisella* Chevreux; *Megamoera* Bate; *Melita* Leach; *Melitoides* Gurjanova; *Netamelita* J. L. Barnard; *Nippopisella* Stock; *Psammogammarus* S. Karaman; *Quasimelita*, n. g. (p.36); *Rotomelita* J. L. Barnard; *Victoriopisa* Karaman & Barnard.

Diagnosis. Uropod 3 inaequiramous, inner ramus very short, outer ramus primarily 2-segmented, margins spinose. Gnathopods 1 & 2 unequal in size (strongly so in male). Gnathopod 1 often, gnathopod 2 usually, sexually dimorphic. Gnathopod 2 (male) regularly subchelate; ishium not elongate. Peraeopods 5-7, dactyls short, rarely elongate. Pigmented eyes typically small, rounded.

Taxonomic commentary. The *Melita* group contrasts mainly with the *Maera (Ceradocus)* group in which uropod 3 is aequiramous (or nearly so), and gnathopod 1 is rarely sexually dimorphic.

KEY TO NORTH PACIFIC GENERA OF THE *MELITA* GROUP (FAMILY MELITIDAE)

1. Pleon segments 1-3, usually postero-dorsally toothed; urosome segments 1 and 2 with dorsal teeth . . 2.

—Pleon segments smooth or weakly toothed only; urosome 1 and/or 2 often lacking dorsal teeth. . . . . 3.

2. Gnathopod 2 (male), left and right propods large, subequal in size and form; uropod 3, outer ramus of normal width; maxilla 1, inner plate, inner margin setose. . . . . *Abludomelita* complex (p. 8)
—Gnathopod 2 (male) left or right propod and dactyl (not both) grossly enlarged; uropod 3, outer ramus slender, sublinear, rod-like; maxilla 1, inner plate with tuft of apical setae . . . .*Dulichiella* Stout (p. 12)

3. Gnathopod 1 (male), propod and dactyl usually strongly differing from female; anterior lobe of coxa 6 (female) usually modified, often hook-like; coxa 1 expanded distally . . . . . *Melita* Leach (p. 50)
— Gnathopod 1 propod and dactyl regularly subchelate, little (or not) sexually dimorphic; coxa 6 regular, little or not sexually dimorphic; coxa 1 little or not expanded distally . . . . . 4.

4. Coxa 4 of normal size, posterior margin with distinct distal portion and proximal excavation . . . . . *Rotomelita* J. L.Barnard (p. 7)
—Coxa 4 relatively small, posterior margin continuous, lacking proximal excavation . . . . . 5.

5. Uropod 3, outer ramus and terminal segment elongate; maxilla 1, inner plate triangular, apex acute, with inner marginal setae; maxiilla 2, inner plate with facial row of setae . . . *Eriopisa* complex (p. 7)
—Uropod 3, outer ramus normal (may lack terminal segment); maxilla 1, inner plate truncate, setae distal or apical; maxilla 2, inner plate lacking facial row of setae . . . . . 6.

6. Uropod 3, outer ramus 2-segmented . . . . . 7.
—Uropod 3, outer ramus 1-segmented . . . . . 8.

7. Mandibular palp vestigial (1-2 segments); telson apical spines long; eyes normally pigmented; peraeopods 5-7, bases subsimilar . . . . . *Tegano* Karaman & Barnard (Indo-Pacific).
—Mandiubular palp normally 3-segemnted, setose; telson sp[ines short; pigmented eyes small or lacking; peraeopods 5-7, bases strongly dissimilar. . . . . *Eriopisella* complex (p. 7)

8. Gnathopods 1 & 2 powerfully subchelate, raptoral (both sexes); peraeopods 5-7 slender, elongate; . . . . . *Carnarimelita* Bousfield (p. 7)
—Gnathopods 1 & 2 moderate, normally subchelate; peraeopods 5-7 not elongate . . . . . 9.

9. Eyes pigmented; peraeopods 5-7, bases nroadening posteriorly; pleon plate 3, hind corner acute; telson lobes bluntly rounded . . . . . *Netamelita* J. L. Barnard (p. 7)
—Pigmented eyes lacking; peraeopods 5-7, bases narrow; pleon plate 3, hind corner squared; telson lobes apically acute . . . . . *Anchialella* J. L. Barnard (Galapagos)

Aberrant members of the *Melita* subgroup, outside the study region, include *Josephella* Stock, 1988, and *Thalassostygius* Vonk, 1990. The *Allomelita* subgroup includes *Allomelita* Stock, 1980 (Type species -*A. pellucida* Sars) and is allied to the *Eriopisella* subgroup.

In the western north Pacific, the *Eriopisella* subgroup contains *Nippopisella nagatai* (Gurjanova, 1965), *N. propagatio* (Imbach, 1967), *Eriopisella sechellensis* (Chevreux), fide Nagata (1965), and *Netamelita* (?) sp. (Ishimaru, 1994). In the eastern North Pacific it contains *Netamelita cortada* J. L. Barn-ard, 1962. Extralimital genera of this group include *Indoniphargus* Straskrabe, 1967, *Micronipharqus* Schellenberg, 1934, and *Gininiphargus* Karaman & Barnard, 1979.

In the Asiatic North Pacific the *Eriopisa* subgroup contains *Victoriopisa ryukyuensis* Morino, 1991, and *Eriopisa elongata* (Bruzelius) fide Nagata (1965), a record questioned by Barnard & Barnard (1983). On the North American Pacific coast, *Psammogammarus garthi* (J. L. Barnard, 1952) is unrecorded north of southern California.

Carnarimelita Bousfield, 1989, to date contains only the monotypic species *C. janstocki*, endemic to anchialine habitats of the Hawaiian islands. The genus is unique in having gnathopod 1 of both sexes powerfully subchelate and raptorial and a loss (probably secondary) of sexual dimorphism in both gnathopods.

The *Rotomelita* subgroup encompasses *Rotomelita* J. L. Barnard, 1977, with the type species, *R. lokoa* Barnard, and R. ana Barnard from the Hawaiian islands; and the IndoPacific genera *Nainiloa* Karaman & Barnard, 1979; *Quadrus* Karaman, 1984; and *Tegano* Karaman & Barnard, 1982.

Abludomelita generic complex, new
(Fig. 1)

Melita Leach (part), Barnard & Barnard, 1983: 664.—Nagata, 1965: 293 (part).
Abludomelita G. S. Karaman, 1981: 39 (part).—Ishimaru, 1994: 49.

Type Genus. *Abludomelita* Karaman, 1981: 39.

Genera: *Desdimelita*, new genus. (p. 40); *Megamoera* Bate, 1862; *Melitoides* Gurjanova, 1934; *Quasimelita*, new genus (p. 36).

Diagnosis. Members of the *Abludomelita* subgroup differ from *Melita* (Leach) in the following character states: pleon segments 1-3 variously toothed postero-dorsally, or smooth; urosome segments 1 & 2 invariably with one or more dorsal teeth; gnathopod 1 (male), palm of propod and dactyl not modified, differing only slightly from female; coxa 6 (female) little or not sexually dimorphic, lacking hook-like antero-ventral lobe; and maxilla 2, inner plate variously with submarginal facial setae. They differ from species of *Dulichiella* in gnathopod 2 (male), in which the left and right propods are subequal in size and form, and not abnormally large, and in maxilla 1, inner plate, in which the inner margin is setose along inner margin rather than apically.

Taxonomic and distributional commentary. The species included in Karaman's original listing for the genus *Abludomelita* encompass most of those listed here under the five component genera of the complex (below).

The five component genera of the *Abludomelita* complex here recognized are keyed below, and principal diagnostic features are illustrated in figure 1. The pleon dorsum is strongly toothed in *Abludomelita* and *Megamoera,* weakly (or not) toothed in *Melitoides* and *Quasimelita* and smooth in *Desdimelita.* In gnathopod 1, the basis, carpus, and propod are strongly setose in *Melitoides* and *Quasimelita,* but relatively weakly setose in *Abludomelita, Megamoera* and *Desdimelita.* In gnathopod 2, the carpus is short and deep in *Abludomelita, Melitoides* and *Desdimelita,* but relatively elongate and shallow in *Megamoera* and *Quasimelita.* The propodal palmar margin is most strongly toothed in *Melitoides* and *Quasimelita,* less so in *Aludomelita,* and least in *Megamoera* and *Dentimelita.* The dactyl is heaviest, .smoothest, and distally bluntest in *Abludomelita,* intermediate in *Desdimelita,* but acutely tipped and strongly setose (outer margin) in *Megamoera, Melitoides* and *Quasimelita.* The inner plate of maxilla 2 bears a strong, deeply submarginal row of facial setae in *Abludomelita* and *Desdimelita*, less strong in *Megamoera*, and weakest and most closely submarginal in *Melitoides* and *Quasimelita.*

The 33 component species (of the 5 genera) are mainly littoral and sublittoral, in arctic and arctic boreal regions of the Arctic, North Atlantic, and North Pacific Oceans. A few species are bathyal and abyssal. The genus *Abludomelita* Karaman, sens. str., occurs in temperate and tropical littoral marine waters of the Mediterranean and western Indian Oceans. None penetrates mesohaline or fresh waters.

KEY TO NORTH PACIFIC GENERA OF THE *ABLUDOMELITA* COMPLEX

1. Pleosome segments 1-3 with postero-dorsal teeth; urosome segment 1 with 3+ posterodorsal teeth . . 2.

—Pleosome segments 1-3 lacking postero-dorsal teeth; urosome segment 1 often or usually with single stout postero-dorsal tooth . . . . . 3.

2. Pleon segments 1-3, postero-dorsal tooth with single accessory tooth (on none) on each side; gnathopod 2 (male), dactyl heavy, broad, distally blunt, outer margin nearly smooth; telson lobes, spines deeply subapical, not set in lateral notches; maxilla 2, inner plate with strong submarginal or oblique facial row of setae . . . . . .*Abludomelita* Karaman (p. 9)

—Pleon segments 1, 2 & 3, postero-dorsal tooth with two or more accessory teeth; telson lobes, spines closely subapical, set in lateral notches; gnathopod 2 (male), dactyl attenuate, apex acute, outer margin variously setose; maxilla 2, facial setae closely submarginal or reduced . . . . . .*Megamoera* Bate (p. 15)

3. Uropod 3, outer ramus 1-segmented; pleon plate 3, hind corner rounded or squared. . . . . *Melitoides* Gurjanova (p. 33)

—Uropod 3, outer ramus 2-segmented; pleon plate 3, hind corner variously produced, acute . . . . . 4.

4. Gnathopod 2 (male), dactyl strongly setose; ibid, carpus broader than deep . . .*Quasimelita* n. g. (p.36)

—Gnathopod 2 (male), dactyl lacking outer marginal setae; ibid, carpus narrow, deeper than broad . . . . . .*Desdimelita* n. g. (p. 40)

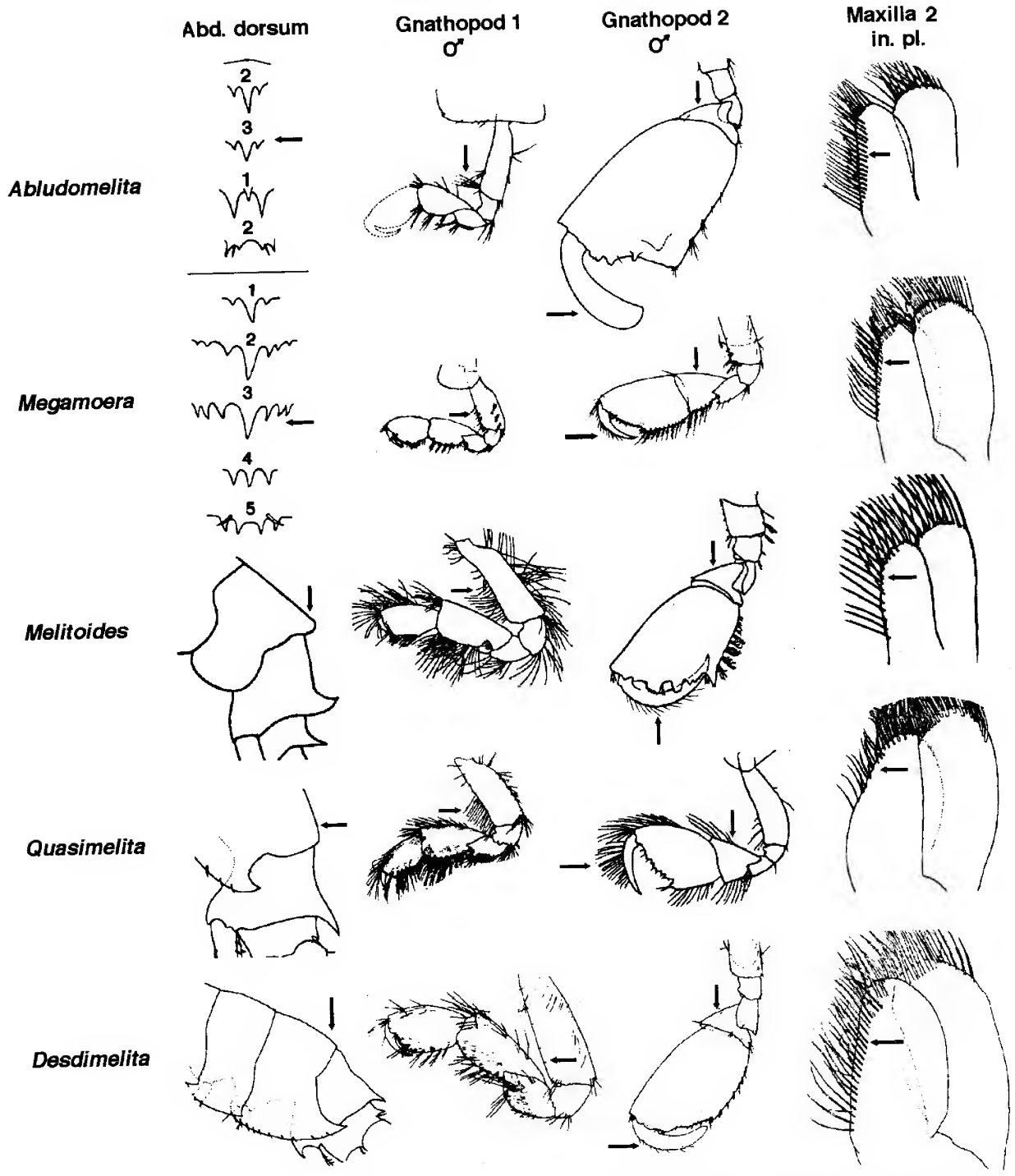

FIG. 1. CHARACTER STATES WITHIN THE *ABLUDOMELITA* COMPLEX OF GENERA.

Abludomelita Karaman (sens. str.)

Abludomelita Karaman, 1981: 39.—Karaman, 1982: 246.

Type species. *Melita gladiosa* Bate, 1862: 346.

Species. *Abludomelita obtusata* (Montagu, 1813); *A. aculeata* (Chevreux, 1911); *A. excavata* (Ledoyer, 1974); *?A. macheira* (K .H. Barnard, 1940).
North Pacific species: *Abludomelita somovae* (Bulycheva, 1952); *A. unamoena* (Hirayama, 1987). *A. denticulata* (Nagata, 1965); *?A. japonica* (Nagata, 1965); *?A. tenuicornis* (Stimpson, 1856) (nomen nudum).

Species incertae sedis: *?A. richardi* (Chevreux, 1900); *?A. solada* J. L. Barnard, 1961.

Diagnosis. Head, inferior antennal sinus simple, squarish. Antenna 1, peduncular segment 3 short. Pleon segments 1- 3, dorsal posterior tooth with single accessory teeth

(if present); pleon 3, dorsal teeth often weak or lacking. Urosome segment 1 with single dorsal posterior tooth. Urosome 2 with paired dorso-lateral cusps, each astride single spine.

Upper lip rounded below. Lower lip, inner lobes small, low, but distinct. Mandible, spine row strong, with 7-10 blades; right lacinia 3-dentate; palp weak, segment 2 usually shorter than 3; segment 1 often large, lacking cusp. Maxilla 1, outer plate with 9 apical spines; inner plate triangular, inner distal margin setose; palps dissimilar, segment 1, lateral setae weak or lacking, segment 2 little expanded, apex (right maxilla) with short spines. Maxilla 2, inner plate, inner face with strong (20-30) oblique or distally submarginal row of setae. Maxilliped, palp segment 2 columnar; dactyl stout.

Coxae 1-3 with hind marginal cusp; coxa1 broadened distally; coxa 4 antero-distally broadest, not deeper than coxa 3. Gnathopod 1 little or not sexually dimorphic; propod expanding distally, dactyl normal, unmodified. Gnathopod 2 (male), carpus short, deep; propod large, broadening distally, postero-distal angle produced or toothed, palm strongly toothed, hind margin with few (3-5) setal clusters; dactyl heavy, distally broad, outer marginal setae very weak or lacking, tip closing in groove between median facial spine cluster and postero-distal angle. In female, propod usually broadening distally; outer margin of dactyl smooth.

Peraeopods 3 & 4 normally slender, 3 larger; dactyls medium strong. Peraeopods 5-7, bases regular, hind lobes distinct, that of 5 little shorter than 6 & 7; segment 4 of peraeopod 6 longer than in 5 or 7; dactyls medium strong.

Pleon plate 3, hind corner usually produced, acute, upper and/or lower margins serrate. Pleopods normal, peduncles not setose. Uropod 1, rami subequal, longer than peduncle. Uropod 2, rami longer than peduncle, outer ramus the shorter, apices spinose. Uropod 3, inner ramus, apex often acute, outer ramus 2-segmented, not elongate, terminal segment distinct.

Telson lobes separated to base, each narrowing distally to acute apex; distal spine clusters deeply subapical, notches evanescent, inner marginal spines lacking.

Coxal gills large, gill 6 only slightly the smallest.

Taxonomic and distributional commentary. This taxonomically restricted group is confined to the Mediterranean region and northwestern Indian Ocean (Madagascar). Two somewhat aberrant members reach the western North Pacific. Component species exhibit a mixture of relatively apomorphic and plesiomorphic character states within the *Abludomelita* complex of genera (fig. 39, p. 64).

The genus *Abludomelita* sens. str. is warm-temperate-tropical in biogeographic affinities, and mainly littoral-sublittoral in depth range. It contrasts markedly with the other 5 generic components whose members are essentially arctic-boreal and boreal in thermal affinities and littoral-sublittoral to deep slope and abyssal in depth range. Members of northern genera have not yet been recorded from anti-boreal regions of the southern hemisphere, however.

"Melita" richardi Chevreux is placed here provisionally because of its dorsal abdominal teeth and dentition of pleon plate 3. Mouthparts & other critical characters of that species are undescribed. Similarly, *M. amoena* is placed here, but pleon plate 2, hind corner, is also acutely produced (fig. 8).

Western Pacific species of *Abludomelita* Karaman. Material of *Abludomelita* spp. from the western North Pacific region was not examined during the present study. However, published descriptions of that fauna are sufficiently detailed to confirm the overall correctness of previous assignments to the genus *Abludomelita* Karaman, 1981. Character state differences have been noted in earlier work and herewith, and these may yet prove significant at supraspecific taxonomic levels.

The type species of *Abludomelita, A.gladiosa* (Bate, 1862), is illustrated in figure 2. Other Mediterranean regional species, e.g., *A. aculeata* (Chevreux) and *A. obtusata* (Montagu) are similar in the following character states:

Pleon segments 1-3 dorsally dentate; urome segments 1 & 2 dorsally dentate; pleon plate 3, hind margin with accessory denticles; maxilla 2, inner plate with distinct deeply submarginal facial row of setae; gnathopod 1 very weakly or not sexually dimorphic; gnathopod 2 (male), carpus short, deep; propod large, distally broadening, with strongly toothed palm, and heavy blunt-tipped, weakly (or not) setose dactyl. Moreover, the head sinus is relatively broad, squarish, and the outer ramus of uropod 3 is relatively short and weakly spinose marginally.

By contrast, species of *Abludomelita* from the Sea of Japan (below) differ in some of these features, and in others, as noted below.

Abludomelita unamoena (Hirayama)
(Fig. 3)

Melita unamoena Hirayama, 1987: 7, figs. 225-226.— Ishimaru, 1994: 51.

Taxonomic commentary. *Abludomelita unamoena* differs from Mediterranean regional species in the narrow propod of gnathopod 2 (female) and the unproduced apices of the telson lobes. Except for the dorsally toothed pleosome, several character states (of mouthparts, pleon plates and uropods) are similar to those of *Desdimelita* n. g. (p. 39). Its similarity to *Megamoera amoena* (Hansen), noted by Hirayama (loc. cit.), appears largely convergent.

Abludomelita somovae (Bulycheva)
(Fig. 4)

Melita somovae Bulycheva, 1952: 226, fig 25.—Barnard & Barnard, 1983: 666.
Abludomelita somovae (Bulycheva) Karaman, 1981: 41.

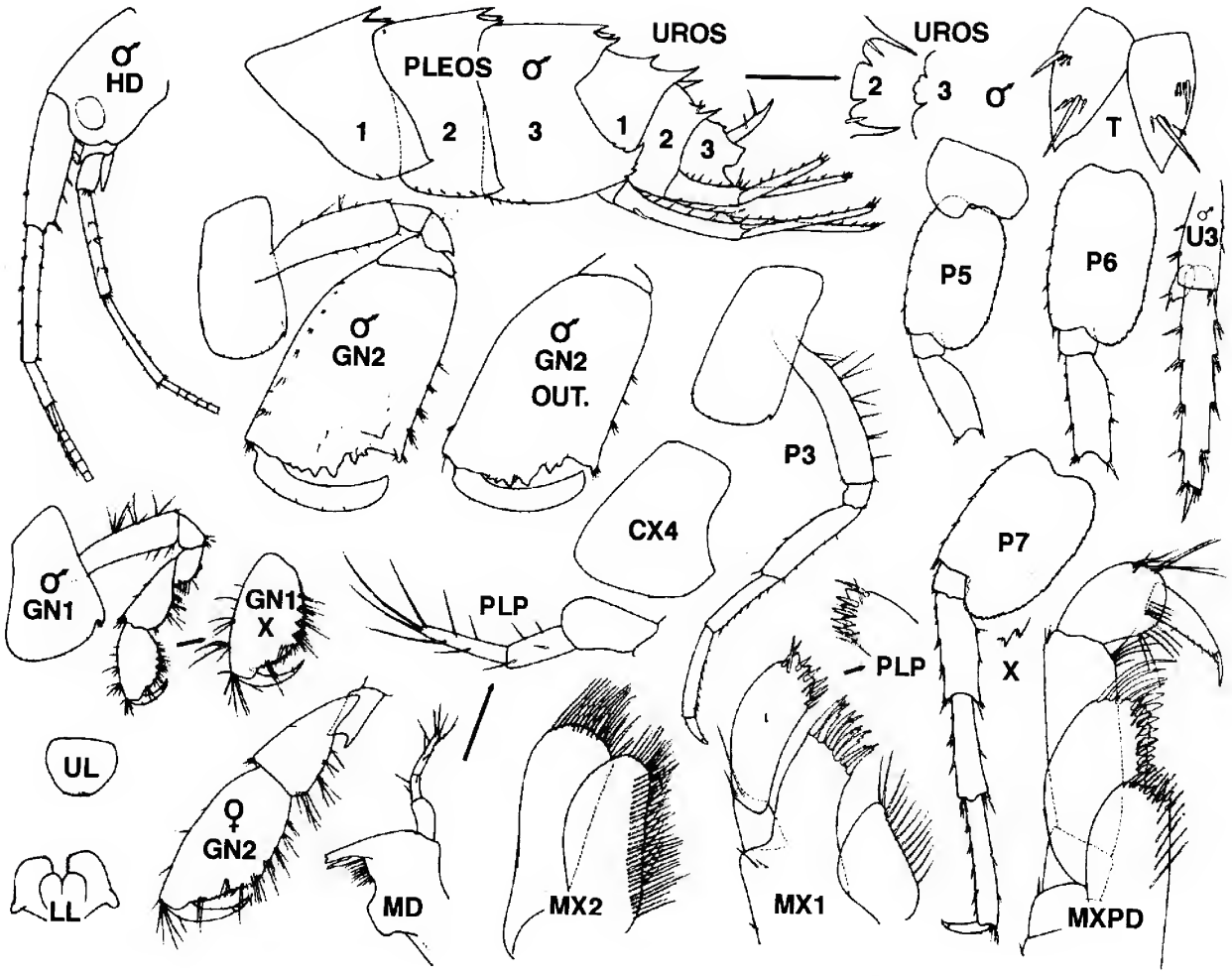

Fig. 2. *Abludomelita gladiosa* (Bate, 1862). Mediterranean Sea. Male (8.0 mm); female (6.0 mm).

Taxonomic commentary. *A. somovae* is similar to *A. unamoena* in the relatively weak dorsal pleonal teeth, and the strong oblique row of facial setae of the inner plate of maxilla 2. The weakly toothed pleon, weakly sexually dimorphic gnathopod 1, and unproduced apices of the telson lobes of *Abludomelita somovae* also trend to those of *Desdimelita,* n. g., endemic to the North American Pacific region.

Abludomelita japonica (Nagata)

Melita japonica, Nagata, 1965: 298, fig. 30.—Barnard & Barnard, 1983: 665.—Hirayama, 1987: 7.
Abludomelita japonica (Nagata) Karaman, 1981: 41.—Ishimaru, 1994: 49.

Taxonomic commentary: Although retaining the dorsally toothed pleosome of *Abludomelita* Karaman sens. str., *A. japonica* shows features of *Desdimelita,* n. g. (p. 39) in the slightly sexually dimorphic gnathopod 1, as well as similarity to *D. desdichada* (Barnard) in peraeopods, uropods, and telson noted previously by Nagata (loc. cit.). The mouthparts have not yet been described.

Abludomelita denticulata (Nagata)

Melita denticulata Nagata 1965: 293, fig. 27.—Barnard & Barnard, 1983: 664.—Hirayama, 1987: 7.
Abludomelita denticulata (Nagata) Karaman, 1982: 41.—Ishimaru, 1994: 49.

Taxonomic commentary: The female of this species conforms generally with Karaman's definition of the genus but differs from the Mediterranean regional type species in its 1-segmented accessory flagellum, and the unproduced apices of the telson lobes. The mouthparts, and gnathopods 1 & 2 of the mature male, have not been described. Lack of setae on the outer margin of the dactyl of gnathopod 2 is inconsistent with other genera of the *Abludomelita* complex.

We may conclude from the consistent differences (above) that Asiatic species of *Abludomelita* are transitional to features of *Desdimelita* of the North American Pacific region. Such differences may prove subgenerically, or perhaps fully generically distinctive, following more detailed examination of fully adult material of all species concerned.

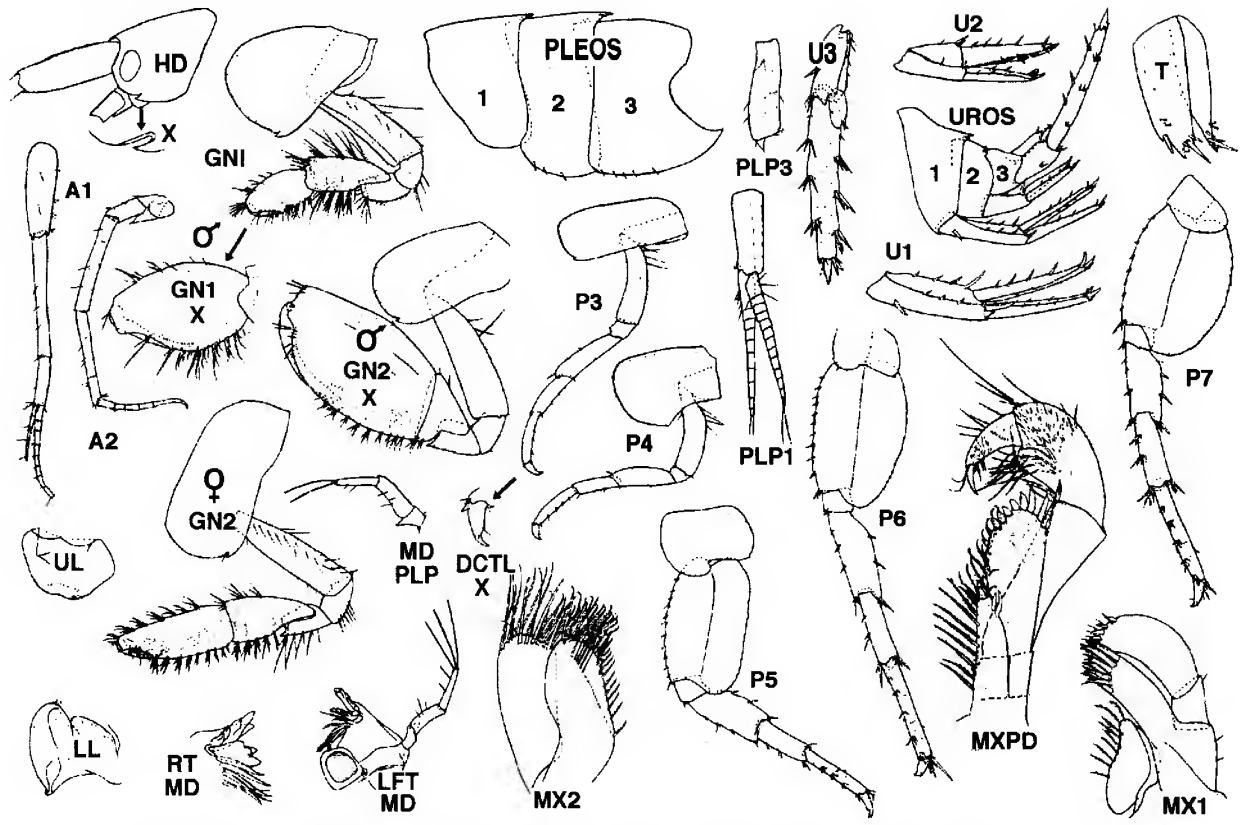

FIG. 3. ***Abludomelita unamoena*** **(Hirayama, 1987). Tomioka Bay, Japan. Male (5.25 mm); female (5.0 mm). (after Hirayama, 1987).**

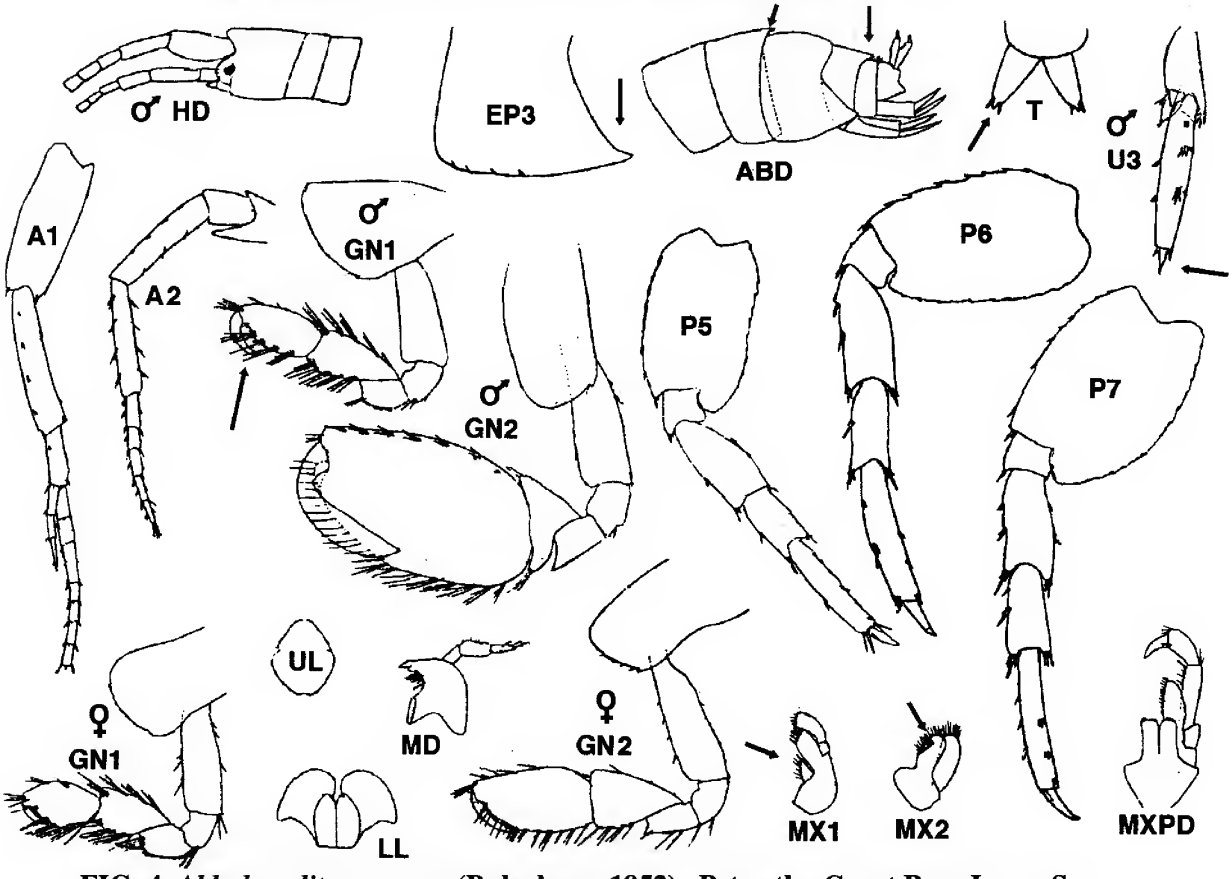

FIG. 4. ***Abludomelita somovae*** **(Bulycheva, 1952). Peter-the-Great Bay, Japan Sea. Male (5.6 mm); female (5.0 mm). (After Buulycheva, 1952).**

Dulichiella Stout, 1912

Dulichiella Stout, 1912: 140.—Karaman & Barnard, 1979: 152.—Barnard & Barnard, 1983: 667.—Ishimaru, 1994: 49.
Melita Stebbing, 1906: 421 (part).—Barnard, 1962: 105 (part).—Barnard, 1969a: 245 (part).—Barnard, 1972a: 67.

Type species. *Dulichiella spinosa* Stout, 1912: 140.

Species. *Dulichiella anisochir* (Kroyer, 1845); *D. australis* (Haswell, 1879); *D. cotesi* (Giles, 1890); *D. exilis* (F. Muller, 1864); *D. grandimana* (Chevreux, 1908); *D. pilosus* (Dana, 1852); *D. setipes* (Dana, 1852); *D. valida* (Dana, 1852).

Taxonomic commentary. Species differences in *Dulichiella* are shown mainly in the palmar toothing and dorsal pleonal armature. Species from the waters of Japan (Kyushu and southern Honshu) have been recorded as *D. appendiculata* by Hirayama and Kikuchi (1979) and Hirayama (1986), and as *D. fresneli* by Irie and Nagata (1962) and Nagata (1965) (see below). On re-examination, these materials will very probably prove new to science, distinct from the species originally described from subtropical and warm temperate parts of the western and eastern North Atlantic Ocean as were *M elita appendiculata* by Say (1812) and as *M. fresneli* by Audouin (1826), respectively.

In many taxonomic features, especially of dorsal armature, mouthparts, gnathopods and telson, this genus closely resembles *Abludomelita* Karaman. In gnathopod 2 of mature males of both genera, the propod is very much enlarged, with a large medial socket into which closes the tip of the heavy baton-like dactyl, the whole presumably functioning as a percussive, sound-producing mechanism.

Dulichiella spinosa Stout

Dulichiella spinosa Stout, 1912: 140.—Karaman, 1981: 39.—Barnard & Barnard, 1983: 667, fig. 45.
Melita spinosa (Stout) Barnard, 1969a: 245.
Melita appendiculata (Say) Barnard, 1969b: 126
Melita fresneli (Audouin) Wailes, 1931: 41?

Material examined. *Dulichiella spinosa* Stout has not been recorded north of Goleta, California. It did not occur in present study material from central California northwards. The record of *Dulichiella fresnell* Audouin from British Columbia by Wailes, 1931, might be a synanthropic introduction but such has not been verified by Chapman (1988). The record remains problematical.

Dulichiella appendiculata (Say)
(Figs. 5, 6)

Melita appendiculata (Say, 1818): 374.—Barnard, 1971: 67, fig. 32A?.—Hirayama & Kikuchi 1979: 68, figs. 1-6?.—Barnard & Barnard, 1983: 667, fig. 45.—Hirayama, 1986: 35?—Austin, 1985: 609?—Ishimaru, 1994: 49?

Diagnosis. Pleon segment 1-3 dorsally toothed and mucronate, weakly setose. Urosome segments 1-3 toothed dorsally and segemnt 3 dosro-laterally. Head lobe broadly rounded, with squared inferior notch. Antenna slender, setose. Antenna 1 slightly longest; peduncular segment 3 short; accessory flagellum distinct.

Upper lip slightly emarginate. Lower lip, inner lobes strongly developed. Mandible, molar strong, with molar flake; spine row strong; palp strongly setosae, 3-segmented, segment 1 with cusp. Maxilla 1, inner plate acute, attenuated distally, with basal and apical setae; outer plate 9-spinose; palp segment 2 expanded; segment 1 with shoulder setae. Maxilla 2, inner plate shorter, with strong facial row. Maxilliped, outer plate short, narrow; palp 2 columnar; dactyl and segment 3 heavy.

Coxal plates relatively shallow, decreasing posteriorly; coxa 4 not excavate behind. Coxae 2 broader than 3. Gnathopod 1 (male), propod and dactyl regular, unmodified. Gnathopod 2, right side similar to gnathopod 1 and female; left gnathopod, propod & dactyl grossly enlarged; palm with 2-3 large outer marginal teeth; dactyl distally stout, rounded tip closing on concavity of strongly and oblique process at posterior palmar angle.

Peraeopods 3 & 4 regular, setose, dactyls short. Peraeopods 5-7, bases not expanded, sublinear; segment 6 slightly broadening distally, hind margin with strong setal clusters; dactyls medium, with outer tooth or cusp.

Pleon plates 1 & 2, hind corners acumninate; plate 3, hind corner produced, acute. Pleopods, rami slender. Uropods 1 & 2, rami relongate, sublinear, >peduncle. Uropod 3, inner ramus small; outer ramus sublinear, strongly spinose, terminal segment distinct.

Telson lobes divergent, apices sharply acute.

Distribution. Tropical and warm-temperate, coastal marine regions of the Indo-Pacific, including Hawaii, and the central Atlantic region. Occurs mainly in high salinity (outer) portions of estuaries, often associated with sponges and corals, and occasionally on *Macrocystis* holdfasts (Barnard, 1969b).

Taxonomic commentary. In many taxonomic features such as the facial setae of maxilla 2, and the form of the propod and dactyl of gnathopod 2 (male), *Dulichiella* closely resembles *Abludomelita* (see phenogram, fig. 39, p. 64).

A previous literature record of *Melita appendiculata* from the B. C. region has been queried by Austin, 1985. This species has also not been recorded by Chapman (1988) among species introduced to the North Pacific region, and likewise remains problematical for the study region. Summer surface temperatures in the Strait of Georgia are presumably sufficiently high, but winter temperatures and summar salinities may be too low to ensure survival of such a warm-temperate species that is native to warm salt estuaries of the southeastern United States.

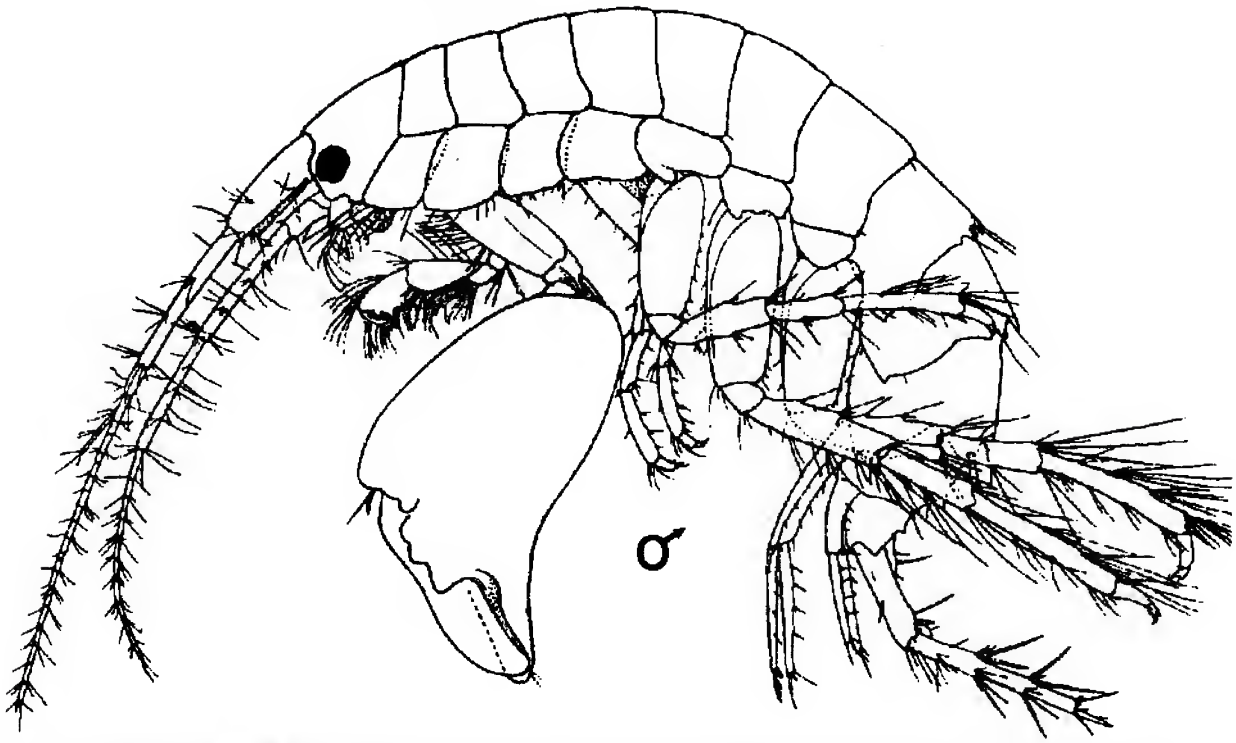

FIG. 5. *Dulichiella appendiculata* (Say). North American Atlantic. Male (After Barnard, 1971).

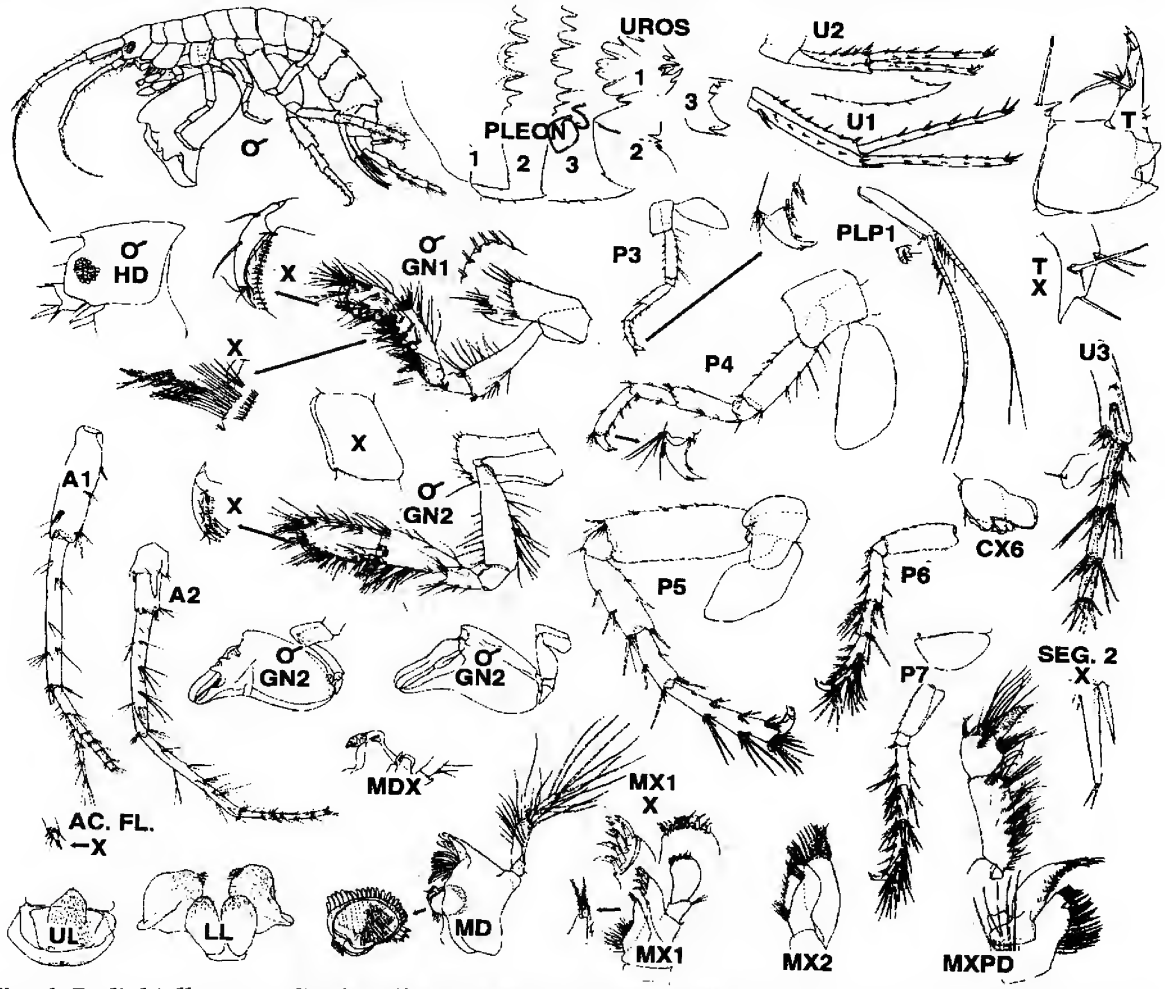

Fig. 6. *Dulichiella appendiculata* (Say) Tomioka Bay, Japan. Male (7.5 mm); female (6.0 mm). (after Hirayama & Kikuchi, 1979)

Megamoera Bate (revived status)

Megamoera Bate, 1862: 225.
Melita Stebbing, 1906: 425 (part).—Gurjanova, 1951: 738 (part).—Barnard, 1969a: 245 (part).—Barnard & Barnard, 1983: 663(part).
Abludomelita Karaman, 1981: 40 (part)?

Type species. *Gammarus dentatus* Kroyer, 1842: 530 (selected J. L. Barnard, 1969: 245).

North Pacific Species: *M. subtener* (Stimpson, 1864) (p 20); *M. bowmani*, new species (p. 22); *M. rafiae*, new species (p. 22); *M. unimaki*, new species (p. 25); *M. glacialis*, new species (p. 27); *M. borealis*, new species (p. 27); *M. mikulitschae* (Gurjanova, 1953) (p. 30); *M. kodiakensis* (J. L. Barnard, 1964) (p. 32); *Megamoera amoena* (Hansen, 1887) (p. 17).

Other species. *Megamoera pallida* (G. O. Sars, 1879); *Megamoera? lignophila* (J. L.Barnard, 1961).

Diagnosis. Pleosome segments 1-3, postero-dorsal tooth usually present,usually with two or more accessory teeth on each side. Urosome segment 1, postero-dorsal tooth usually with 1-3 accessory teeth on each side. Urosome 2 with dorso-lateral pairs of teeth each astride single spine. Head, anterior head lobe rounded, lower margin often with small accessory process; inferior antennal sinus narrowly notched. Antennae regular, antenna 2 much shorter than antenna 1.

Mouthparts regular. Upper lip shallowly notched. Lower lip regular, inner lobes well developed. Mandible, spine row with numerous blades (8-14); left lacinia 4-dentate, right lacinia 4-5 dentate; palp segment 3 usually longer than 2; segment 1 short, with acute medial process. Maxilla 1, inner plate triangular, tip not attenuated, inner margin 6-14 setose; outer plate with 9 apical spines; palp segment 1 usually with strong lateral setae; segment 2 moderately expanded distally. Maxilla 2, inner plate, facial setae variously reduced, closely marginal or submarginal. Maxilliped, outer plate medium large; palp segment 2 slightly broadened; dactyl medium.

Coxae 1-4 medium to shallow, 1-3 cuspate behind. Coxa 1 variously expanded distally; coxa 4 excavate behind, not deeper than 3. Gnathopod 1 small, weakly sexually dimorphic; basis, antero-distal setae variously developed; carpus elongate, shallow; propod relatively narrow, shorter than carpus, palm and dactyl slightly modified; in female, posterior margin of dactyl often denticulate or microsetose. Gnathopod 2 (male), carpus generally short, hind lobe narrow, deep,apex (margin) setose; propod large, slightly broadening distally, palm oblique, usually toothed, with distinct hinge tooth, inner face with submarginal postero-distal spine cluster, posterior margin strongly setose (5-10 clusters); dactyl variously setose anteriorly, tip attenuated; in female, carpus relatively long but much shorter than propod, medium deep; propod relatively large (smaller than in male), slightly narrowing distally, palm regularly convex, with postero-distal tooth.

Coxa 6 (female), anterior lobe shallow, often subequally bifid. Peraeopod 4 slightly smaller than 3. Peraeopod 5, basis not grossly smaller than in 6 & 7; in all, bases regularly expanded, hind lobes normal; segment 4 slightly broadened; distal segments regular; dactyls typically medium short.

Pleon plates 1 & 2, hind corners squarish or acuminate, rarely produced; pleon plate 3, hind corner usually produced, acute, upper and lower margins not serrate. Uropod 1, peduncle with disto-lateral spine; rami sublinear, spinose, often shorter than peduncle. Uropod 2, rami shorter than peduncle, outer ramus the shorter. Uropod 3, outer ramus not elongate, terminal segment distinct. Telson lobes regular, separated almost to base, marginal spines subapical, set in lateral and medial notches.

Coxal gills 2-5 large, 6 often distinctly smallest. Brood plates sublinear, short.

Taxonomic and distributional commentary. *Megamoera* encompasses about a dozen arctic and subarctic species, extending southwards in the North Pacific region mainly along the North American coast.

Barnard (1969a) resurrected *Gammarus dentatus* Kroyer, 1942 as the type of *Megamoera* Bate, 1862, that had long been synonymized within *Melita* Leach, 1814. Restriction of the generic name *Melita* to species of the *palmata* type, by Karaman (1981), renders Bate's generic name available for species of the *dentata* type, as herein diagnosed.

The generic status of *Melita lignophila* J. L. Barnard, 1961, from Gulf of Panama deeps, and the Asiatic North Pacific species *Melita japonica* Nagata, 1965 are uncertain. several characters, especially of the mouthparts, have apparently not been described nor figured. In both species, the dorsal abdominal dentition is unlike that of other species of *Megamoera* (e.g., pleon segment 1 lacks dorsal teeth, and urosome segment 1 lacks lateral denticle(s)). Barnard (loc. cit.) noted the resemblance of *M. lignophila* to *M. richardi* (Chevreux, 1900) which, because of the serrated margins of the hind process of pleon plate 3, is here related more closely to *Abludomelita* Karaman, 1981, sens. str. In *M. japonica*, the propod of gnathopod 1 is distinctly sexually dimorphic and, in the male, more slender and longer than the carpus. The mouthparts, peraeopods, uropods, etc., have not been described in detail, but generally likened to those of other members of the Asiatic variant of *Abludomelita* (see above, p. 11). Pending more detailed information, therefore, "*Melita*" *lignophila* is not treated further, nor included in the key to species of *Megamoera* (p. 16).

Melita amoena Hansen, 1888, from sublittoral depths of the Greenland Sea is included here and in the key (p. 16) because of comparison with *Megamoera unamoena* by Hirayama, 1987, from the western north Pacific, and as a probable member of the genus *Megamoera*.

KEY TO NORTH PACIFIC SPECIES OF *MEGAMOERA*

1. Pleon segments 1-3 each armed postero-dorsally with stout median tooth and 2 lateral denticles on each side; telson lobes, proximal subapical notch located on inner (medial) margin; gnathopod 1 (male), propod subovate, palm very oblique, merging with hind margin ..... 2.
—Pleon segments 1-3 with unlike combinations of median and lateral accessory denticles; telson lobes, proximal subapical notch located on outer (lateral) margin); gnathopod 1 (male) propod broadest distally, palm usually steep or nearly vertical, sharply angled from posterior margin ..... 3.

2. Peraeopods 6 & 7, bases large, length (depth) >1.5x basis of peraeopod 5; coxa 1 expanded distally; telson lobes with 2 inner marginal spines ..... *M. glacialis* n. sp. (p. 27)
—Peraeopods 6 & 7 bases regular, length <1.5 X basis of peraeopod 5; coxa 1 not broadening distally; telson lobes lacking inner marginal spines ..... *M. borealis* n. sp. (p. 27)

3. Pleon plate 1, postero-dorsal marginal teeth minute or lacking; pleon plate 3, hind corner squarish; uropod 1, outer ramus distinctly shorter than inner ..... *M .kodiakensis* (Barnard) (p. 31)
—Pleon plate 1, postero-dorsal maginal teeth distinct; pleon plate 3, hind corner variously produced, acute, uropod 1, rami closely subequal ..... 4.

4. Gnathopod 2 (male), anterior margin of dactyl with a few weak setae; maxilla 1, palp segment 1 with few (1-3) lateral setae; maxilla 2, inner plate, with strong submarginal row of facial setae ..... 5.
—Gnathopod 2 (male), anterior margin of dacty strongly setose; maxilla 1, palp segment 1 with (5+) lateral setae; maxilla 2, inner plate, facial setae reduced, marginal in position ..... 7.

5. Pleon segments 1 & 2 , central postero-dorsal tooth with 4 fine denticles on each side; urosome 1, mid-dorsal tooth with 2 fine denticles on each side; telson, apical spines long. *M. subtener* (Stimps.) (p. 20)
—Pleon segments 1 & 2, central tooth with 2-3 stout lateral teeth on each side; urosome 1, mid-dorsal tooth with single stout lateral tooth on each side; telson, apical spines short ..... 6.

6. Telson with 1 long apical spine; gnathopod 1 (male), propod, palm short, very oblique; dactyl with basal expansion or swelling ..... *M. rafiae* n. sp. (p. 22)
—Telson with 2 long apical spines; gnathopod 1 (male), propod, palm normal, nearly vertical; dactyl normal, slender, little expanded basally ..... *M. bowmani* n. sp. (p. 22)

7. Pleon segment 3 with postero dorsal tooth and 5 denticles on each side; pleon plate 3, hind corner acute but little produced; coxa 4 broad, as deep as coxa 3, lower margin horizontal; head with distinct lower marginal process. ..... *M. mikulitschae* (Gurjanova) (p. 30)
—Pleon segment 3 with postero-dorsal tooth and 1-3 denticles on each side, or lacking entirely; pleon 3, hind corner strongly produced, acute; coxa 4 normal, not deeper than coxa 3, lower margin oblique; anterior head lobe, lower margin simple ..... 8.

8. Pleon segment 3, postero-dorsal teeth minute or lacking; urosome 1, dorsal tooth lacking lateral denticles; gnathopod 2 (male), palm with several strong teeth ..... *M. amoena* (Hansen) (p. 17)
—Pleon segment 3 with conspicuous postero-dorsal tooth and lateral denticles; urosome 1 with dorsal tooth and lateral denticle; gnathopod 2 (male), palm weakly toothed or with hinge tooth only ..... 9.

9. Pleon segments 1 & 2, postero-dorsal tooth with 1-3 lateral denticles on each side; telson, apical spines long; uropod 3, proximal segment of outer ramus slender, with 5-6 clusters of marginal spines ..... *M. dentata* (Kroyer) (p. 17)
—Pleon segments 1 & 2 each with single postero-dorsal tooth; telson, apical spines short; uropod 3, proximal segment of outer ramus regular, margins each with 4-5 spine clusters .. *M. unimaki* n. sp. (p. 25)

Megamoera dentata (Kroyer)
(Figs. 7, 9)

Gammarus dentatus Kroyer, 1842: 530, fig. 29.
Megamoera dentata (Kroyer) Bate, 1962: 225. t. 39, fig. 4.
Melita dentata (Kroyer) Sars, 1895: 513, pl. 181, fig. 1.—Stebbing, 1906: 427.—Gurjanova, 1951: 740, fig. 518.—Shoemaker, 1955: 49.—Barnard, 1969b: 126.—Bousfield, 1973: 65, pl. IX.1.—Karaman, 1981: 43 (+ synonymies).—Barnard & Barnard, 1983: 664.—Ishimaru, 1994: 50 (part)?

Material Examined.
ALASKA: Unimak Island, P. Slattery coll., June-October, 1982. - 1 female br. I (15.0 mm). CMN collections, Ottawa.

Diagnosis. Female br. I (15.0 mm). Pleon segments 1-3 with centre tooth and 1-3 lateral denticles on each side; pleon 3 with centre tooth and 3 denticles. Urosome segment 1 with central tooth and1-2 lateral denticles; urosome 2 with 2 pairs of short teeth and single spines. Anterior head lobe strongly rounded, lower margin smooth, inferior notch small. Eye rounded, small to medium. Antenna 1, peduncular segment 3 short; accessory flagellum 4-5-segmented; flagellum ~35-segmented. Antenna 2, flagellum short, little longer than peduncular segment 5, 18-segmented.

Mandible, spine row with 10-12 blades; palp, terminal segment with 8-10 setae. Maxilla 1, inner plate with 15 marginal setae; palp segment 1 with 2 lateral setae. Maxilla 2, facial setae of inner plate reduced (12-15), distal, closely submarginal. Maxilliped, inner plate with 8 inner marginal setae; outer plate with 6 merging curved spines and 2 outer setae; dactyl, long, straight.

Coxa 1 not expanded distally, anterior margin sharply rounded. Coxa 4 relatively narrow, lower margin convex, oblique, antero-distally sharply rounding. Gnathopod 1, propod short, nearly as deep as long, palm gently convex, nearly vertical; dactyl finely serrate along inner margin. Gnathopod 2, propod subrectangular, longer and broader than carpus, palm oblique, nearly straight, weakly toothed, 2/3 length of hind margin; dactyl, outer margin strongly setose.

Peraeopods 3-4 unequal, dactyls medium. Peraeopods 5-7, bases regular, hind margins finely crenulate; dactyls medium.

Pleon plates 2, hind corner acuminate; pleon 3, hind corner moderately produced, acute. Uropods 1 & 2, rami elongate, strongly spinose, tips extending beyond peduncle of uropod 3, outer ramus shorter. Uropod 3, outer ramus slender, margins with 5-6 clusters of short spines; terminal segment short, length about twice basal width.

Telson lobes slender, diverging distally, fused basally; lateral and medial subapical notches about equidistant from apices; subapical and inner marginal spines medium length; inner marginal spine(s) short.

Coxal gill 6 markedly shorter and narrower than gill 5. Brood plates slender, medium.

Male (to 28 mm). Gnathopod 1, basis antero-distally weakly setose; carpus relatively long and shallow with distinct, setose lower margin; propod shorter, expanding distally, palm long; dactyl regular, lacking proximal bulge. Gnathopod 2, carpus relatively long, medium deep, lower margin distinctly setose; propod large, subrectangular, slightly broadening distally, palm oblique, with strong hinge tooth, hind margin wtih 10-12 setal clusters; dactyl stout, apex blunt, outer margin with a few short setae.

Distributional Ecology. Widely distributed around arctic shores, extending south to Cape Cod in the western Atlantic, and to the northern Sea of Japan in the western N. Pacific.

Common on rocky and sedimentary bottoms, at littoral to sublittoral depths.

Taxonomic commentary. The type species shows considerable variation in material from Europe, eastern North America, and the Bering Sea. However, the number of dorsal teeth on pleonal and urosomal segments compares closely with that of similar sized females from Hudson Bay, Canadian Arctic, and from Spencer I., Nova Scotia.

Megamorea amoena (Hansen)
(Fig. 8)

Melita amoena Hansen, 1887: 147.—Stebbing, 1906: 426.—Gurjanova, 1951: 750, fig. 519.—Barnard & Barnard, 983: 664.

Diagnosis. Male (8.5 mm): Pleon segments 1 & 2 with 1 and 5 very small postero-dorsal teeth respectively; segment 3 unarmed. Urosome segment 1 with 2 small dorsal teeth; urosome 5 with 2 minute dorsal teeth. Antenna 2, peduncular segments 4 & 5 subequal. Coxae 1-4 relatively narrow and shallow. Gnathopod 2, carpus very short, small, lobe narrow; propod very large, broadening distally, palm oblique, convex, strongly but irregularly toothed; outer margin of dactyl with several setae.

Peraeopods 5-7, bases very broad, hind margins convex, finely crenulate, hind lobes distinct; dactyls short. Pleon side plates 2 & 3, hind corners acute, produced. Uropods 1 & 2, rami relatively short, extending little beyond peduncle of uropod 3. Uropod 3, outer ramus 1-segmented.

Taxonomic and distributional commentary. Regrettably, the mouthparts, telson, coxal gills and brood plates have not been described. The species exhibits character states of *Quasimelita* and *Melitoides*, but in balance, it is best retained within *Megamoera* until further study.

This species was taken intitially from off East Greenland at a depth of 56 m., has not been recorded at shelf depths from the North Pacific study region.

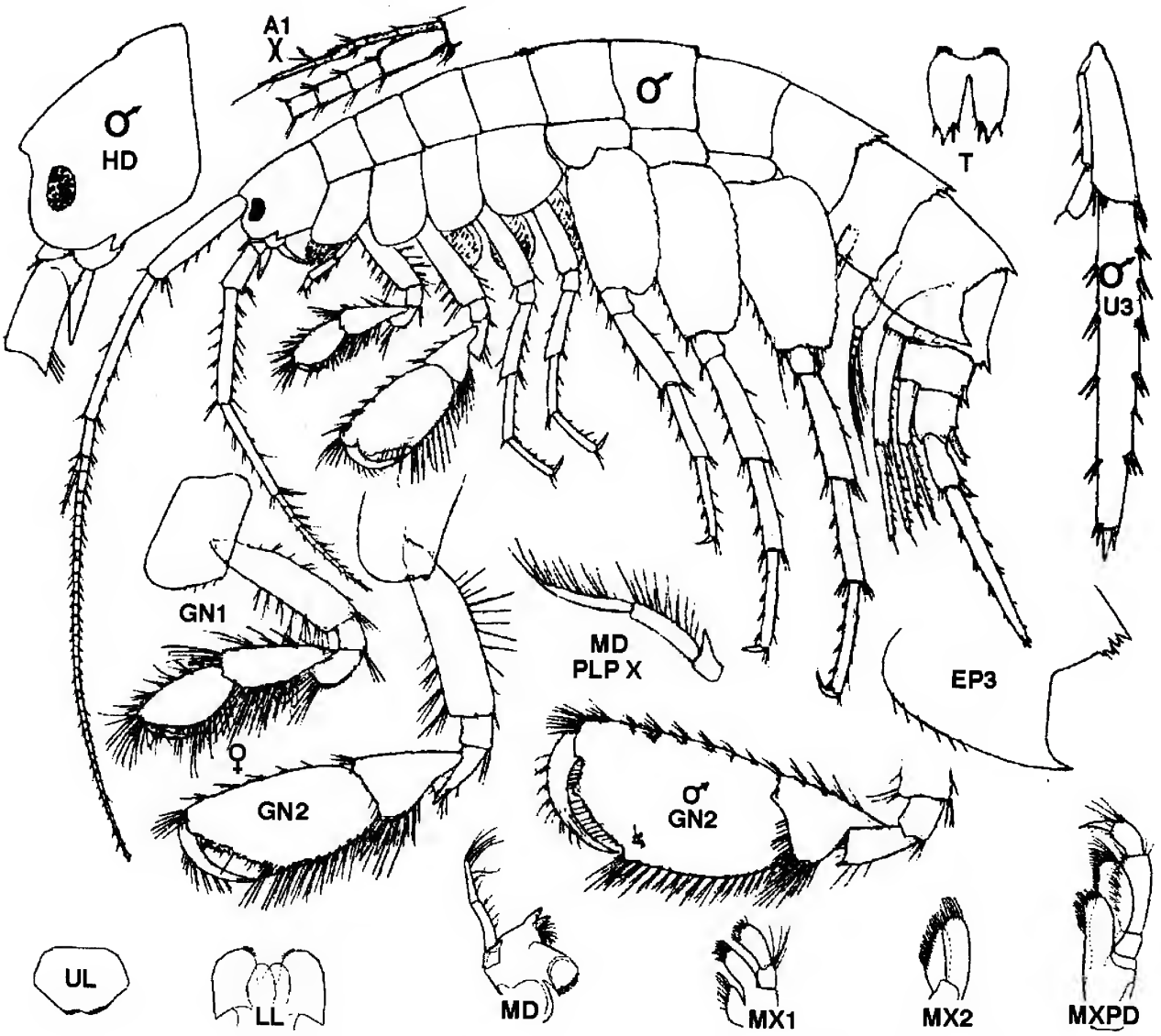

Fig. 7. ***Megamoera dentata*** **(Kroyer, 1842). Norwegian Sea. Male (16.0 mm); female (12.0 mm). (after Sars, 1895).**

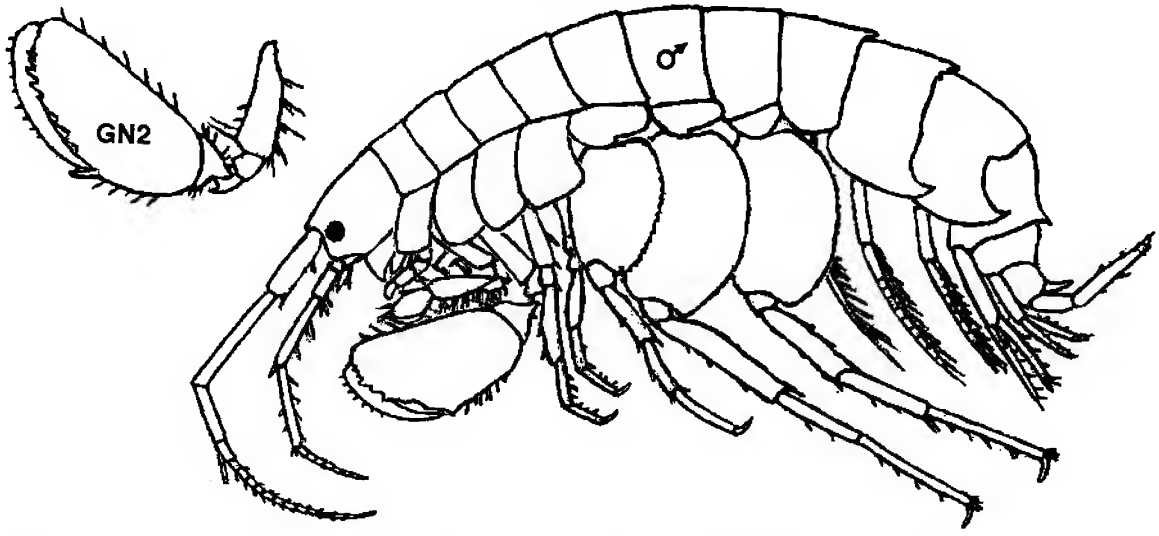

Fig. 8. ***Megamoera amoena*** **(Hansen, 1887). Greenland Sea. Male (8.5 mm) (after Gurjanova, 1951).**

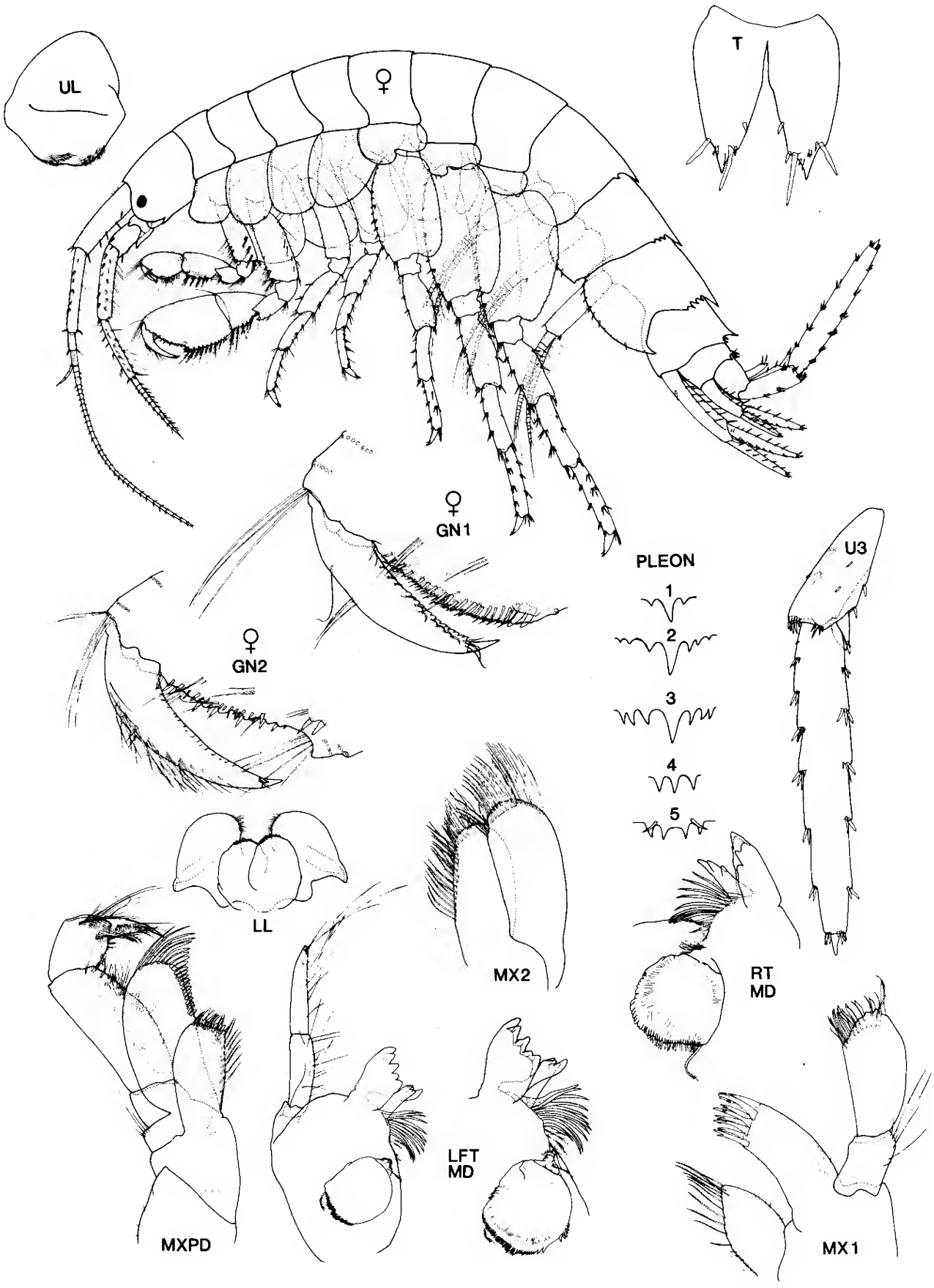

Fig. 9. ***Megamoera dentata*** **(Kroyer, 1842) Unimak I., Female (15.0 mm).**

Megamoera subtener (Stimpson)
(Fig. 10)

Gammarus subtener Stimpson 1864: 167.—Stebbing, 1906: 742.— Shoemaker, 1955: 49.
Abludomelita subtener (Stimpson) Karaman, 1981: 40.
non *Melita dentata* (Kr.) Shoemaker, 1955: 49.—Barnard, 1958: 57.—Barnard, 1969b: 126.—Austin, 1985: 610.—Staude, 1987: 384.

Material Examined. More than 500 specimens at 81 stations, as follows:
ALASKA:
Southeastern Alaska, ELB Stns., 1961: A 30 (Murder Cove) - male (12.0 mm) (figured specimen); also 19 other localities, intertidal to 10 m. - ~350 specimens, incl. males, females, juveniles.

BRITISH COLUMBIA:
Queen Charlotte Islands, ELB Stns., July-August, 1957, 11 stations (incl. E9, E14, E17, E18, E24, E25 H8b, H11, W3a, W4b), intertidal to 30 m. depth - 8 males, 8 females, 2 juveniles.
North-central mainland coast, ELB Stns., July, 1964: N16 (Port Neville), intertidal - 1 female; 12 other localities, intertidal to 24 m. - 16 males, 16 females, 45 juveniles.
Burrard Inlet, ELB Stn. E4 (Roche Pt)., Nov. 4, 1977, 8 m., sand - 1 juvenile.
Vancouver Island, north end, ELB Stns., July, 1959: 6 localities (V3, V7, V11, V17, V19, V21), intertidal to 65 m. - 1 male, 4 females, 4 juveniles.
Vancouver Island, south end, ELB Stns., August,1955: P2 (Tofino Pt.), intertidal - 1 female, 2 juveniles.
ELB Stns., July, 1970: P712 (David I., Trevor Channel) - 1 female ov. (10.0 mm (figured specimen); 4 other localities, intertidal, bedrock and sand - 5 males 4 females, 3 juveniles.
ELB Stns., August, 1975: 3 localities (P17a, P22, P25), intertidal to 30 m., sand, shell, stones - 12 female, few juveniles.
ELB Stns., June-July, 1976: 5 localities (B4, B10c, B10d, B11b, B26), intertidal to 35 m., sand, sandy mud - 28 specimens, mostly juveniles.
ELB Stns., May, 1977: B4a (Piper's Lagoon), intertidal and subtidal, stones and boulders - 2 juveniles; B13 (Trevor Channel), 6-14 m., hard sand - 2 males.
Saanich inlet, K.E.Conlan Stn II014, 5 m. - 1 female; Stn. II061, 4 m. - 2 males, 1 female; Stn. II062, 5 m. - 9 males and females.

WASHINGTON: ELB Stn., Friday Harbor, 1966 - 13 specimens including males, females, juveniles.

OREGON: ELB Stns., 1966: W64 (Netart's Bay), intertidal, coarse sand, gravel, shells - 13 males, females.

Diagnosis. Male (12.0 mm). Pleon segments 1 & 2 with centre tooth and 4-6 lateral denticles on each side; pleon 3 with centre tooth and 3 denticles. Urosome 1 with central tooth and paired lateral denticles. Urosome 2 with 2 pairs of short teeth and single spines. Anterior head lobe shallow, lower margin with prominent accessory process. Eye round, medium. Antenna 1, accessory flagellum 6-segmented; flagellum ~35-segmented. Antenna 2, flagellum slender, 18-segmented.

Mandible, spine row with 10-12 blades; palp segment 3 not strongly setose (10-12 setae). Maxilla 1, inner plate with 15 marginal setae; palp segment 1 with 2 lateral setae. Maxilla 2, facial setae of inner plate numerous (30+), in medial submarginal row. Maxilliped, inner plate with 8 inner marginal setae; outer plate with 6 merging curved spines and 2 outer setae; dactyl, long, straight.

Coxa 1 distally broadened, anterior margin broadly rounded. Coxa 4, lower margin convex, oblique, antero-distally sharply rounding. Gnathopod 1, basis antero-distally weakly setose; propod relatively short, deep, palm distinct, smooth, oblique; dactyl with weak proximal bulge. Gnathopod 2, carpus, hind lobe narrow, apex weakly setose; propod large, subrectangular, slightly broadening distally, palm oblique with low median and dactylar teeth, hind margin with 10-12 setae clusters; dactyl stout, apex blunt, outer margin with a few short setae.

Peraeopods 3-4 unequal, dactyls medium. Peraeopods 5-7, bases regular, hind margins crenulate; dactyls medium.

Pleon plates 1 & 2, hind corners acuminate; pleon 3, hind corner moderately produced, acute. Uropods 1 & 2, rami elongate, strongly spinose, tips extending beyond peduncle of uropod 3. Uropod 3, outer ramus stout, margins with 5-6 clusters of longish spines; terminal segment distinct, length 3-4 X basal width.

Telson lobes slender, diverging distally, fused basally; proximal notch positioned laterally; apical, subapical and inner marginal spines long.

Coxal gill 6 slightly shorter than gill 5.
Female ov. (10.0 mm). Head sexually dimorphic, female with single inferior marginal tooth. Gnathopod 1, propod short, little longer than deep, palm nearly vertical. Gnathopod 2, propod longer and more slender than carpus, tapering distally, palm oblique, nearly straight, length 2/3 that of hind margin; dactyl with 6-8 outer marginal setae. Brood plates slender, short.

Distributional ecology. From Prince William Sound and southeastern Alaska, through British Columbia, Washington, and Oregon to central California. Habitat: outer surf coast, LW level to subtidal, under stones and kelp.

Taxonomic and distributional commentary. This species cannot really be confused with *M. dentata* because of character states of the head region and others outlined in the key. The correctness of its synonymy with *M. dentata*, by the authors above, is therefore seriously in question . No other species, superficially like *M. dentata*, ranges from British Columbia into the Central California coast.

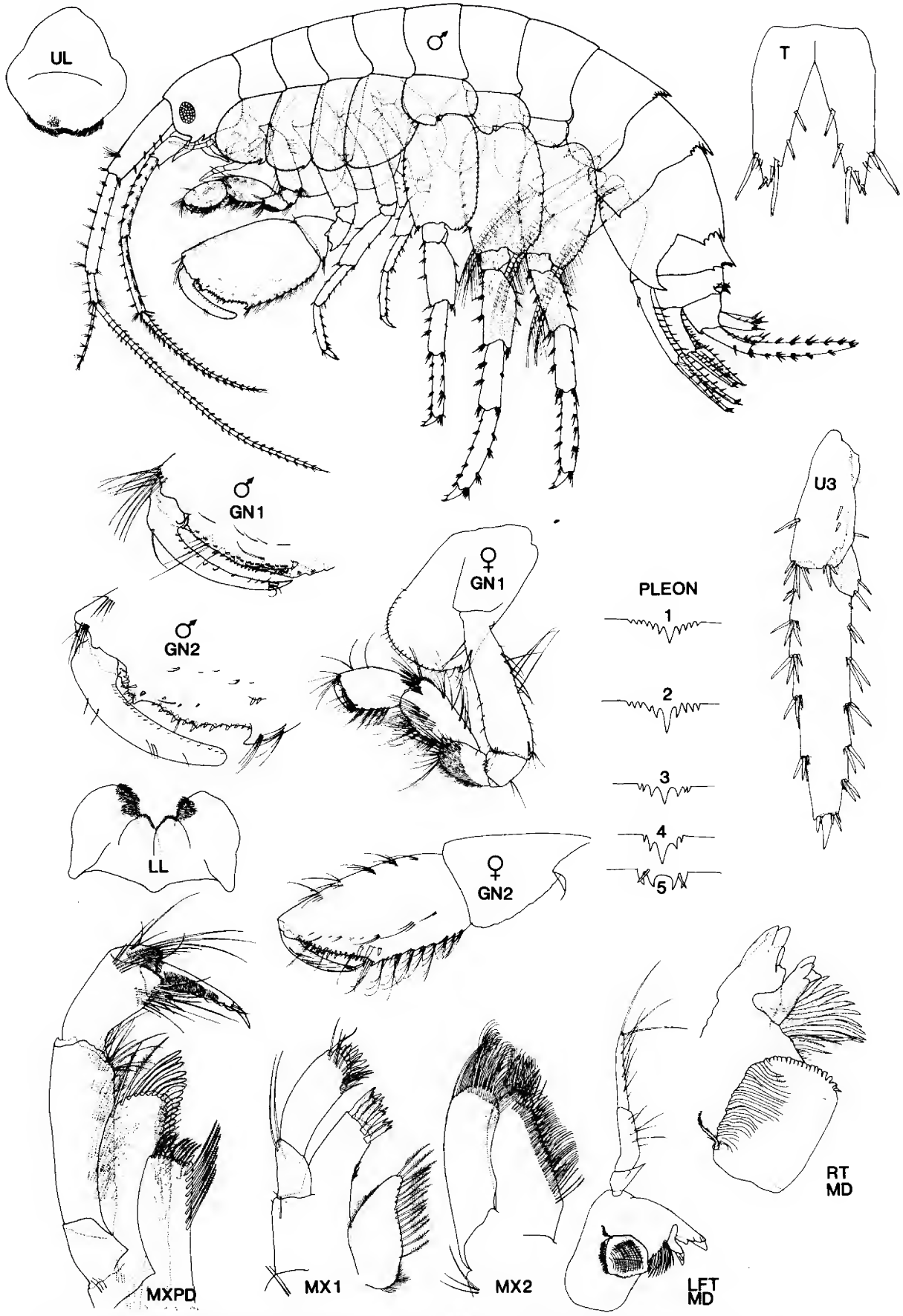

Fig. 10. ***Megamoera subtener*** **(Stimpson, 1864). Male (12.0 mm). Murder Cove (A30), Allaska. Female (10.0 mm).. David I. (P712), Trevor Channel, B. C.**

Megamoera rafiae, new species
(Fig. 11)

Material Examined:
ALASKA:
Southeastern Alaska, ELB Stns., 1961: A30 (1 male); A48 (Scraggy I.) - male (12.0 mm) **Holotype**; female ov. (10.0 mm) **Allotype**; 50 male, female juvenile **Paratypes**; A30 (Murder Cove) - 1 male; A75 (anterior part of body?). CMN collections, Ottawa.

Diagnosis. Male (12.0 mm). Pleon segments 1 and 2 with low centre tooth and 1-2 strong lateral denticles on each side. Pleon 3 with 3 strong lateral denticles on each side, each about equal in size to centre tooth. Urosome 1 postero-dorsally subequally tridentate; urosome 2 subequally quadridentate. Anterior head lobe shallow, rounded, lower margin with subacute process; inferior antennal notch short, slit-like. Eye medium, round. Antenna 1, peduncular segment 3 medium; accessory flagellum 5-segmented; flagellum ~40-segmented. Antenna 2, flagellum medium, tapering, ~12-segmented.

Mandible, spine row with ~12 blades; palp segment 3 with 9-12 mostly medium setae. Maxilla 1, inner plate with 12 inner marginal plumose setae; palp segment 1 with 3 lateral setae. Maxilla 2, facial setae of inner plate numerous (30+), in medial submarginal row that diverges slightly distally. Maxilliped, inner plate with ~15 inner marginal setae; outer plate, apex subtruncate, with 5 apical curved spines and 3 long setae; dactyl gently curved.

Coxa 1 expanded distally, broadly rounding anteriorly. Coxa 4 narrow, nearly smoothly rounded below. Gnathopod 1, basis with few antero-distal setae; propod small, more slender and shorter than carpus; palm convex, shallowly oblique, almost merging with hind margin, row of bifid spines on either side of palmar margin; dactyl with distinct basal bulge. Gnathopod 2, carpus, hind lobe relatively narrow, lower margin with 2-3 setal groups; propod subrectangular, with 6-8 lower marginal setal clusters, palm convex, weakly toothed; dactyl normal distally attenuated, inner margin finely setulose.

Peraeopods 3 & 4 regular, 4 smaller; dactyls very short. Peraeopods 5-7, bases regularly broadened; dactyls very short, length of each about twice its basal width.

Pleon plates 1 & 2, hind corners blunt; hind corner of plate 3 weakly produced, length ~ basal width. Uropods 1 & 2, rami short, not exceeding peduncle of uropod 3; outer ramus shorter. Uropod 3, outer ramus medium, lateral margins with 4 clusters of short spines; terminal segment small, length about twice its basal width.

Telson lobes stout, little diverging, proximal notch lateral; lateral and medial spines short, medial spine longest.
Coxal gill 6 somewhat the shortest, but relatively broad.

Female (10.0 mm). Head sexually dimorphic, female with single inferior marginal toot. Gnathopod 1, propod short, shallow, subrectangular, palm nearly vertical; dactyl ordinary. Gnatho-pod 2, carpus short, propod relatively stout, little longer than deep, not narrowing distally, deeper than carpus; palm normally oblique, length nearly equal to posterior margin, postero-distal angle with 2 stout spines. Coxa 6, anterior lobe weakly bifid. Brood plates relatively broad.
Colour: The head is grey, mottled with white; the anterior head lobe is white, the eye dark. Peraeopods 5-7 are slightly banded distally.

Etymology. Named in honour of Fahmida Rafi, biologist, formerly with the National Museum of Natural Sciences, Ottawa, in recognition of her long-term assistance in the collecting, sorting, and identification of the North Pacific materials of this study.

Distribution. Taken under stones and boulders at the LW level of rocky shore habitats, at 3 stations in the high boreal region of southeastern Alaska.

Taxonomic commentary. This species is closely similar to *M. bowmani* (below) that is distributed from Southeastern Alaska to North-central British Columbia. However, it differs in characters of the key (p. 16) and in addition, coxa 1 is less strongly broadened, coxa 4 is more broadly rounded below, and the dorsal abdominal teeth are less strong.

Megamoera bowmani, new species
(Fig. 12)

Material Examined.
ALASKA:
Southeastern Alaska, ELB Stns., June-July, 1961: A30 (Murder Cove), intertidal - 2 males; A75 (Kayak Pt.) - 6 males 10 juveniles; A131 (Renard I.) - 2 juveniles.
ELB Stns., July, 1980: S5B1 (NW Hogan I.) - 5 males, 2 female, 7 juveniles.

BRITISH COLUMBIA:
Queen Charlotte Islands: ELB Stn. H3 (mouth of Masset Harbour), Aug. 27, 1957, 2-22m. - male (11.0 mm) **Holotype**; female subad. (7.0 mm) **Allotype;** 14 male, 8 juvenile **Paratypes;** ELB Stns. H3 (22), and H 11(1).

Diagnosis. Male (11.0 mm). Pleon segment 1 with one mid-dorsal tooth and single weak laterals; pleon 2 with low mid-dorsal and 3 weaker lateral denticles on each side; pleon 3 with 3 denticles on each side. Urosome 1 postero-dorsally subequally tridentate. Urosome 2 subequally quadridentate. Anterior head lobe shallow, rounded, inferior margin with distinct acute process; inferior antennal sinus a small sharp notch. Eye smallish, ovate. Antenna 1, peduncular segment 3 short; accessory flagellum 5-segmented; flagellum ~40-segmented. Antenna 2, flagellum tapering, distinctly longer than peduncular segment 5, ~12-segmented.

Mandible, spine row with ~12 blades; palp segment 3 with 8-9 longish setae. Maxilla 1, inner plate with 12 inner marginal plumose setae; palp segment 1 with 2-3 lateral

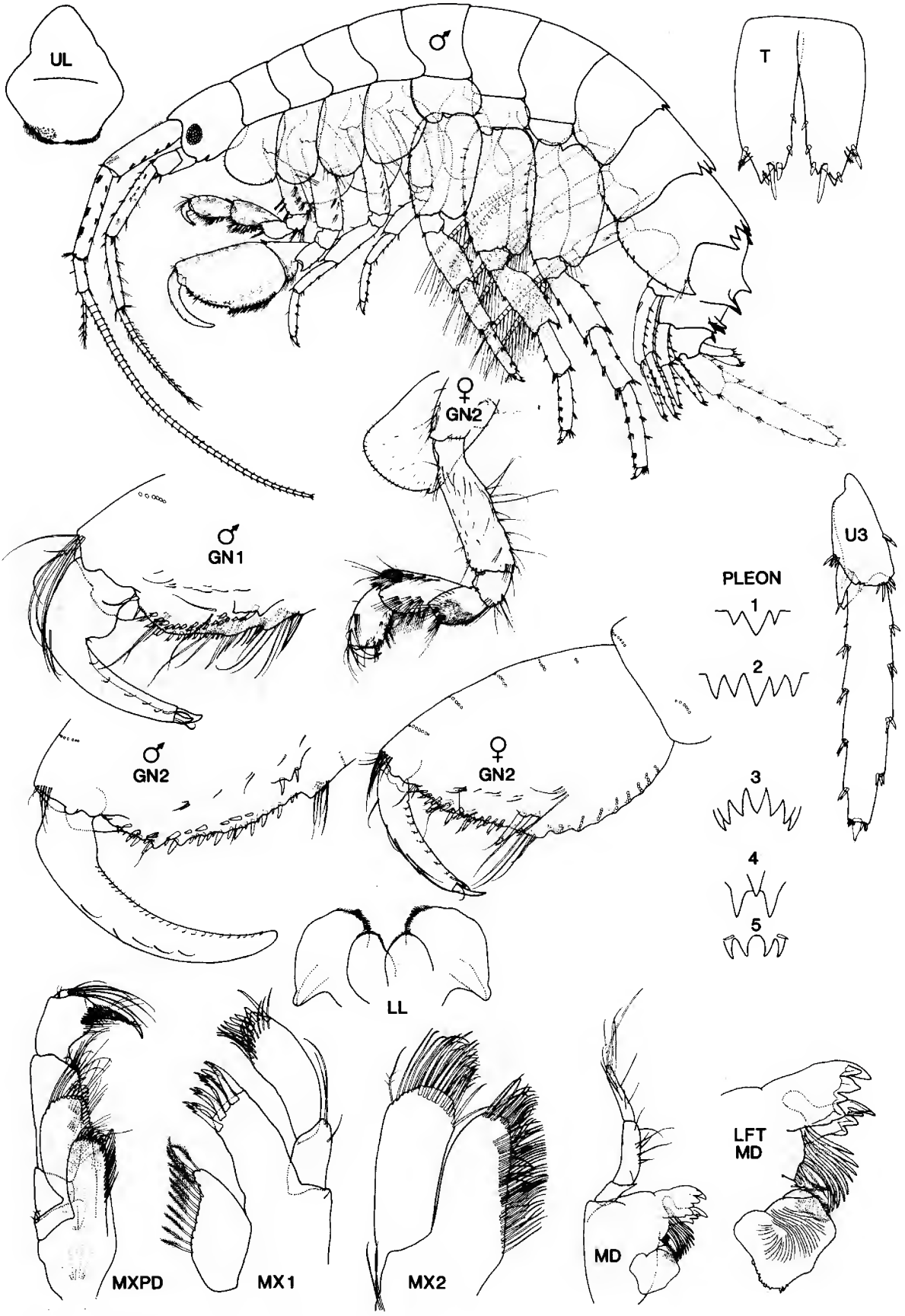

Fig. 11. ***Megamoera rafiae*****, new species. Scraggy I. (A48), Alaska. Male (12.0 mm); female (10.0 mm).**

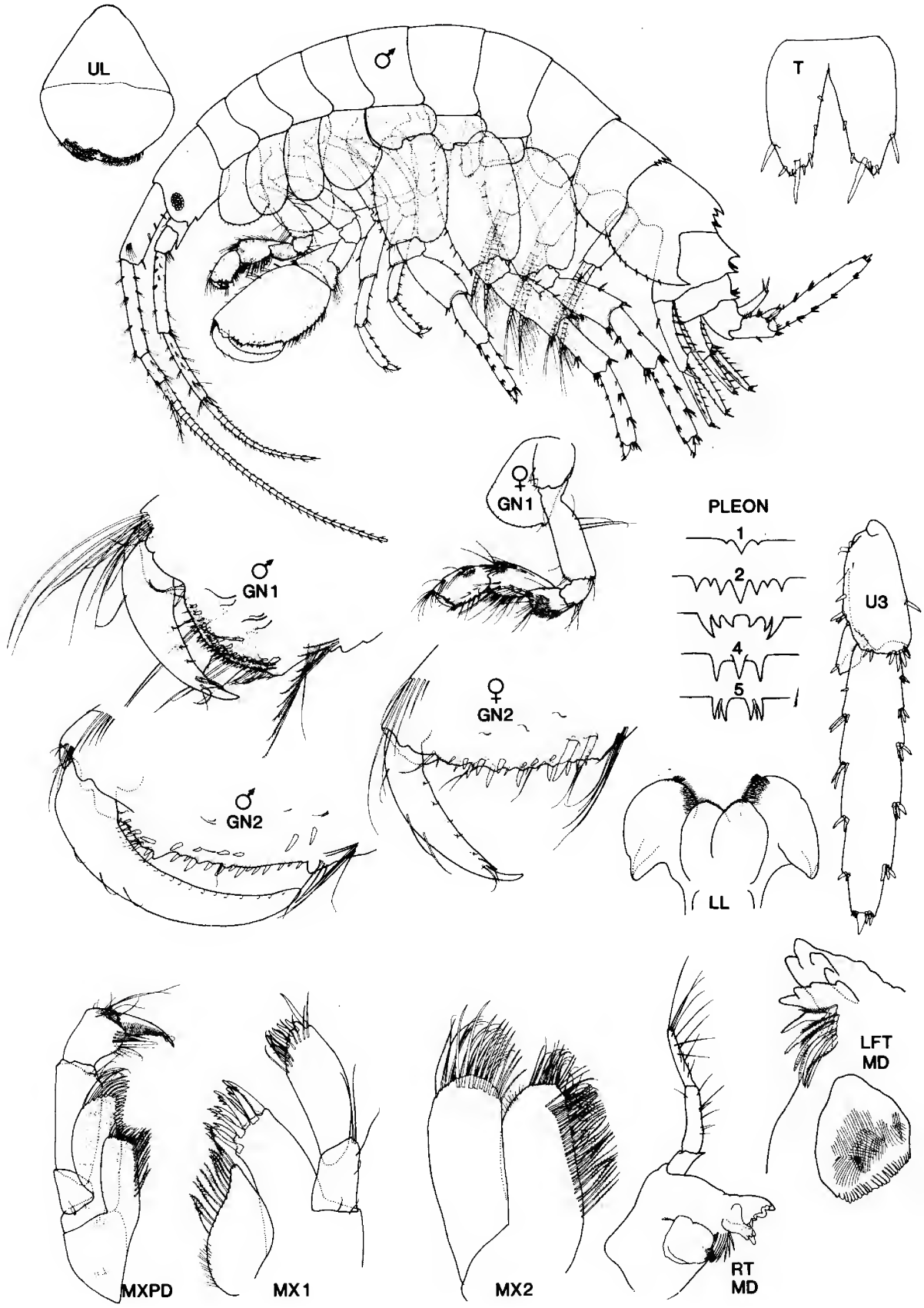

Fig. 12. ***Megamoera bowmani,*** **new species. Off Masset Harbour (H3), Queen Charlotte Islands, B. C. Male (11.0 mm); female (7.0 mm)..**

setae. Maxilla 2, facial setae of inner plate numerous (30+), in distally diverging medial submarginal row. Maxilliped, inner plate with 13 inner marginal setae; outer plate, apex subtruncate, with 5 apical curved spines and 3 long setae; dactyl gently curved.

Coxa 1 not strongly broadened distally. Coxa 4 nearly smoothly rounded below. Gnathopod 1, basis weakly setose anter-distally; propod small, more slender and shorter than carpus; palm strongly convex, smooth, nearly vertical, row of bifid spinules on either side of margin; dactyl with slight basal bulge. Gnathopod 2, carpus relatively shallow, lower margin with ~4 clusters of setae; propod broad, lower margin with 10+ clusters of short setae; palm oblique, convex, with weak hinge tooth; dactyl regular, distally attenuated, outer margin nearly bare.

Peraeopods 3 & 4 normal, 4 smaller; dactyls very short. Peraeopods 5-7, bases large, slightly dissimilar; dactyls very short, length ~ basal width.

Pleon plates 1 & 2, hind corners slightly acuminate; pleon 3 weakly produced, tooth slightly longer than basal width; lower margin moderately spinose. Uropods 1 & 2, rami short, not exceeding peduncle of uropod 3. Uropod 3, outer ramus stout, lateral margins with 5 clusters of short spines; terminal segment short, length ~2X basal width.

Telson lobes stout, basally fused, little diverging distally, proximal notch lateral; apical, and medial marginal spines short; notch spines, medium long, slender. Coxal gill 6 short, relatively narrow.

Female subadult (7.0 mm). Gnathopod 1, propod short, shallow, subrectangular, palm nearly vertical; dactyl normal. Gnathopod 2, carpus relatively short; propod relatively stout palm normally oblique, very weakly toothed, length nearly equal to posterior margin, postero-distal angle with 2 stout spines. Coxa 6, anterior lobe entire (possibly bilobate in mature female).

Etymology. Named in honour of the late Thomas E. Bowman, Smithsonian Institution, Washington, D. C., whose extensive contributions to crustacean systematics embraced several major taxa, including the Amphipoda.

Distributional Ecology. Recorded from the southern part of southeastern Alaska, and the Queen Charlotte Islands, British Columbia, in slatey gravel and organic debris, from LW level to depths of 25 m.

Taxonomic commentary. *Megamoera bowmani* is very closely related to *M. rafiae,* as noted above (p. 22); both are most closely related to *M. subtener* (Stimpson) (p. 20).

Megamoera unimaki, new species
(Fig. 13)

Material Examined.
ALASKA: Aleutian Islands, Unimak I., P. Slattery Stn. C53-C56, June-oct., 1972 - female ov. (13.0 mm) **Holotype** ; 9 female **Paratypes;** Stn. C32 - 4 females, 2 juv.; Stn. C34 - 1 female; Stn. C37b - 1 female, few juv.; Stn. C39 - 1 female CMN collections, Ottawa.

Diagnosis. Female ov. (13.0 mm). Pleon segments 1 & 2 with small postero-dorsal tooth only; pleon 3 with centre tooth and single lateral denticle on each side. Urosome 1 with central tooth and single lateral denticle; urosome 2 with 2 pairs of unequal teeth and single spines. Anterior head lobe strongly rounded; lower margin smooth, inferior antennal sinus a short sharp notch. Eye medium-large, almond-shaped. Antenna 1, peduncular segment 3 short; accessory flagellum 5-segmented; flagellum 20-segmented. Antenna 2, flagellum slender, 9-segmented, subequal to each of peduncular segments 4 & 5.

Mandible, spine row with 14-15 slender blades; palp segment 3 moderately setose. Maxilla 1, inner plate with 20+ marginal setae; palp segment 1 with 5 lateral setae. Maxilla 2, facial setae of inner plate numerous (~25), in closely submarginal medial row, distally diverging. Maxilliped, inner plate with 15+ inner marginal setae; outer plate medial marginal short spines merging apically with 5-6 slender curved spines; dactyl nearly straight.

Coxa 1 little expanded distally, anterior margin sharply rounded. Coxa 4 little broadened, posterior excavation shallow, lower margin oblique, antero-distally sharply rounding. Gnathopod 1, basis antero-distally moderately setose; propod slender nearly as long as carpus, palm distinct, smoothly convex, steeply oblique, margins lined on both sides with many fine spinules, poster-distal angle with sub-marginal cluster of 6 small spines; dactyl strongly serrate behind. Gnathopod 2, carpus relatively short, deep, hind lobe with 6-8 setal clusters; propod relatively large, sub-rectangular, hind margin with 10-12 setal clusters; palm oblique, nearly straight, very weakly toothed; dactyl stout, distally tapering, outer margin strongly setose.

Peraeopods 3-4 slightly unequal, dactyls medium short. Peraeopods 5-7, bases increasing in width posteriorly, hind margins weakly crenulate; segment 4 slightly broadened; dactyls medium short. Coxa 6, anterior lobe shallow, simple.

Pleon plates 1 & 2, hind corners weakly acuminate; pleon 3, hind corner moderately produced, acute, tooth nearly twice length of its basal width. Uropods 1 & 2, rami medium, strongly spinose, tips about level with peduncle of uropod 3; uropod 1, disto-lateral spine strong. Uropod 3, outer ramus stout, margins with 5 clusters of short spines; terminal segment short, length little longer than basal width.

Telson lobes medium, not fused basally, diverging distally; proximal notches lateral, medial notches indistinct; apical, subapical and inner marginal spines short.

Coxal gill 6 markedly shorter and narrower than gill 5. Male unknown, probably of the *M. dentata* type.

Etymology. Named after the type locality on Unimak Island, Aleutian Islands, Alaska.

Distributional ecology. Known only from the type locality, under stones at LW level.

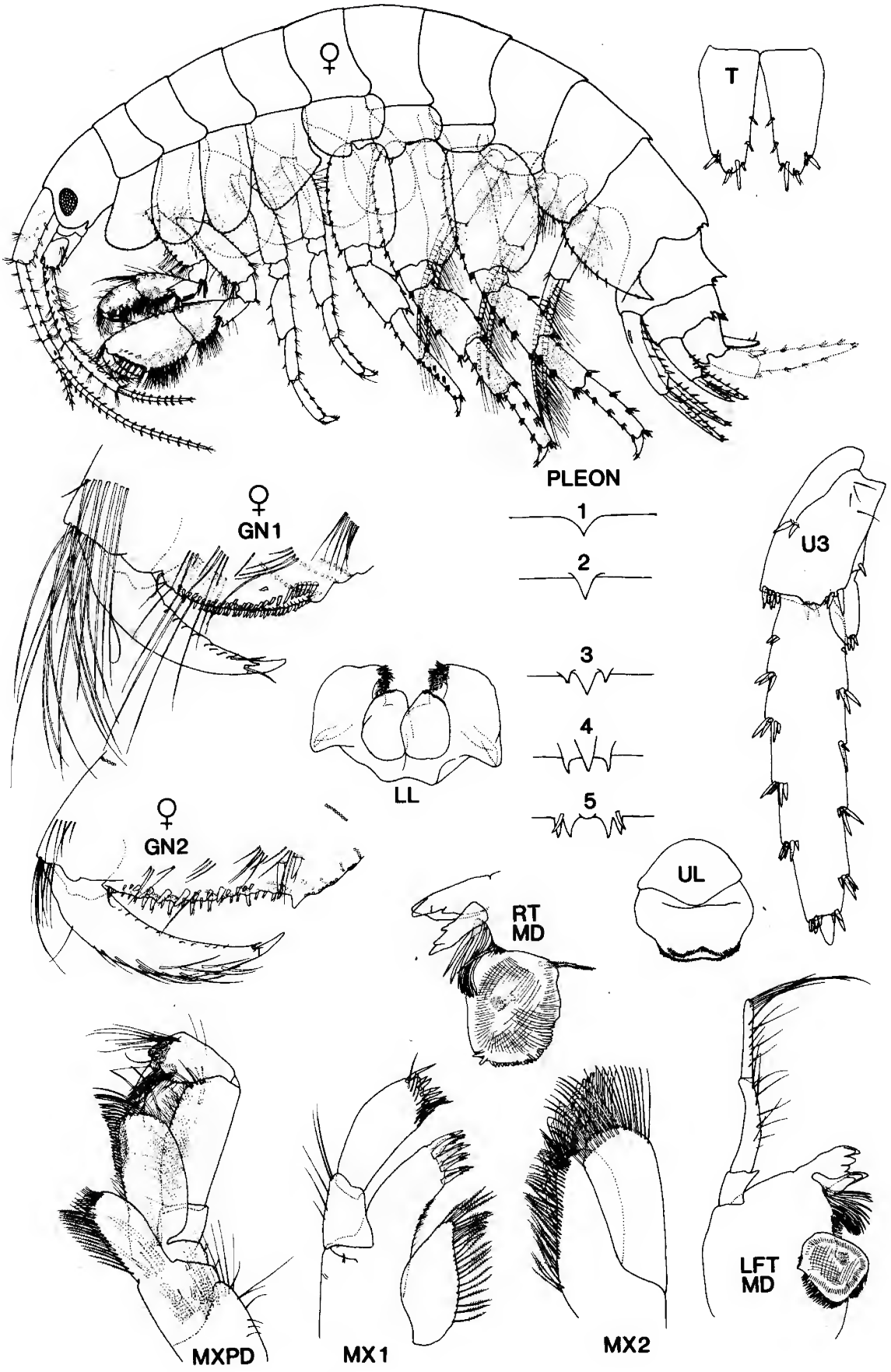

Fig. 13. ***Megamoera unimaki,*** **new species. Unimak I., Aleutian Islands, Alaska. Female (13.0 mm).**

Taxonomic commentary. *Megamoera unimaki* clusters taxonomically closest to *M. glacialis* and *M. kodiakensis*. However, in the serrated dactyl of gnathopod 1, position of facial setae of maxilla 2, etc., the female shows character states similar to those of the type species *M. dentata* (Kroyer).

Megamoera glacialis , new species
(Fig. 14)

Material examined.
ALASKA:
Aleutian Islands. Unimak I., P. Slattery Stns., June-Oct., 1982: C32 - 1 male; C39 - 1 male.
Southeastern Alaska. ELB Stns., July, 1961: A110 (College Fiord), intertidal - male (12.0 mm) **Holotype.**
ELB Stns, Aug. 1, 1980: S17B1 (Kalanin Bay), intertidal - 1 male. CMN collections, Ottawa.

Diagnosis. Male (12.0 mm). Pleon segments 1, 2 & 3 each with medium centre tooth and 2 lateral denticles on each side. Urosome 1 with central tooth and small single lateral denticles. Urosome 2 postero-dorsally with 2 pairs of short unequal teeth and single spines. Anterior head lobe shallow, lower margin with prominent accessory process, inferior sinus a shallow notch. Eye rounded, medium. Antenna 1, peduncular segment 2 slender, peduncle 3 short; accessory flagellum 4-segmented; flagellum elongate, ~35-segmented. Antenna 2, flagellum18-segmented, slightly longer than peduncular segment 5.

Mandible, spine row with 10-12 blades; palp segment 3 medium setose (10-12 long setae). Maxilla 1, inner plate with 13-15 marginal setae; palp segment 1 with 8-10 lateral setae. Maxilla 2, facial setae of inner plate reduced (7-10 setae), in distal medial closely submarginal row. Maxilliped, inner plate with 10 inner marginal setae; outer plate spines relatively slender, merging apically with 6-8 very slender curved spines; dactyl basally stout, straight, unguis curved.

Coxa 1 expanded distally, anterior margin broadly rounded. Coxa 4 relatively broad, lower margin convex, slightly oblique, antero-distally rounding. Gnathopod 1, basis antero-distally weakly setose; propod subovate, about equal in length to carpus, palm smooth, gently convex, very oblique, demarcated from longer hind margin by small tooth; dactyl with weak proximal bulge, inner margin setulose. Gnathopod 2, carpus, hind lobe narrow, distal margin with 2-3 weak setal clusters; propod large, subrectangular, posterior margin distally with 6-7 setal clusters, palm oblique, convex, with low irregular hinge tooth, and stout postero-distal tooth; dactyl stout, apex attenuated, without distinct unguis, outer margin strongly setose.

Peraeopods 3-4 unequal, dactyls medium. Peraeopods 5-7, bases regular, increasingly broad posteriorly, hind margins weakly crenulate; segment 4 narrow; dactyls medium.

Pleon plates 1 & 2, hind corners rounded or square; pleon 3, hind corner not produced, minutely acuminate. Uropods 1 & 2, rami elongate strongly spinose, tips extending beyond peduncle of uropod 3. Uropod 3, inner ramus very short; outer ramus relatively short, stout, margins with 3-4 clusters of medium short spines; terminal segment small, slender.

Telson lobes stout, diverging distally, weakly fused basally; proximal notch medial; notch spines medium long, stout; inner marginal spines short;

Coxal gill 6 much smaller than gill 5.

Female unknown, probably of the *M. unimaki* type; inferior head margin probably with single tooth., a sexually dimorphic feature of N. Americna Pacific members of this genus.

Etymology. From the Latin root "*glacialis*", meaning icy, in reference to the glacial ice floating in the fiord during summer months.

Distributional Ecology. Recorded from the Aleutian Islands, southern Bering Sea, to Prince William Sound, under boulders at LW level.

Taxonomic commentary. *Megamoera glacialis* is very similar to *M. borealis* (Fig. 40, phenogram) in character states of the mouthparts, pleon plate 3, and telson. It is readily distinguished however, by the more broadly expanded bases of peraeopods 5-7, the slightly weaker dorsal abdominal dentition, and the stouter uropod 3 with shorter marginal spines. The mature female is unknown.

Megamoera borealis, new species
(Fig. 15)

Material Examined.
ALASKA:
Aleutian Islands, Unimak I., P. Slattery Stn. 39, June-Oct., 1982 - 1 female ov. (10.0 mm).
Southeastern Alaska, ELB Stns., 1961: A83 (Cordova Bay) (3 males));A110 (College fiord) - male (8.0 mm) **Holotype**; female ov (9.5 mm) **Allotype**; 5 male. 2 female, 6 juvenile **Paratypes**; A150 (Johnson Pt.) - 1 female. CMN coll'ns.

BRITISH COLUMBIA:
North-central coast, C. Levings Stn. 51B-C30 (Swanson Bay), 38 m. dredge, April 4, 1973 - 1 female.
South-central coast, ELB Stn. E3 (Indian Arm), Nov. 4, 1977, dredge - 1 male, 1 female.
Southern Vancouver Island, G. O'Connell Stn..(off McCauley Pt., Victoria), dredge, 66 m. July, 1977 - 2 females.

Diagnosis. Female ov. (9.5 mm) (Allotype). Pleon segment 1 with centre tooth and single small lateral denticle on each side; pleon plates 2 and 3 with small postero-distal tooth and 2 slightly smaller lateral denticles on each side. Urosome 1 with central tooth and single small lateral denticles. Urosome 2 with 2 postero-dorsal pairs of short subequal teeth and single long spines extending well beyond teeth.

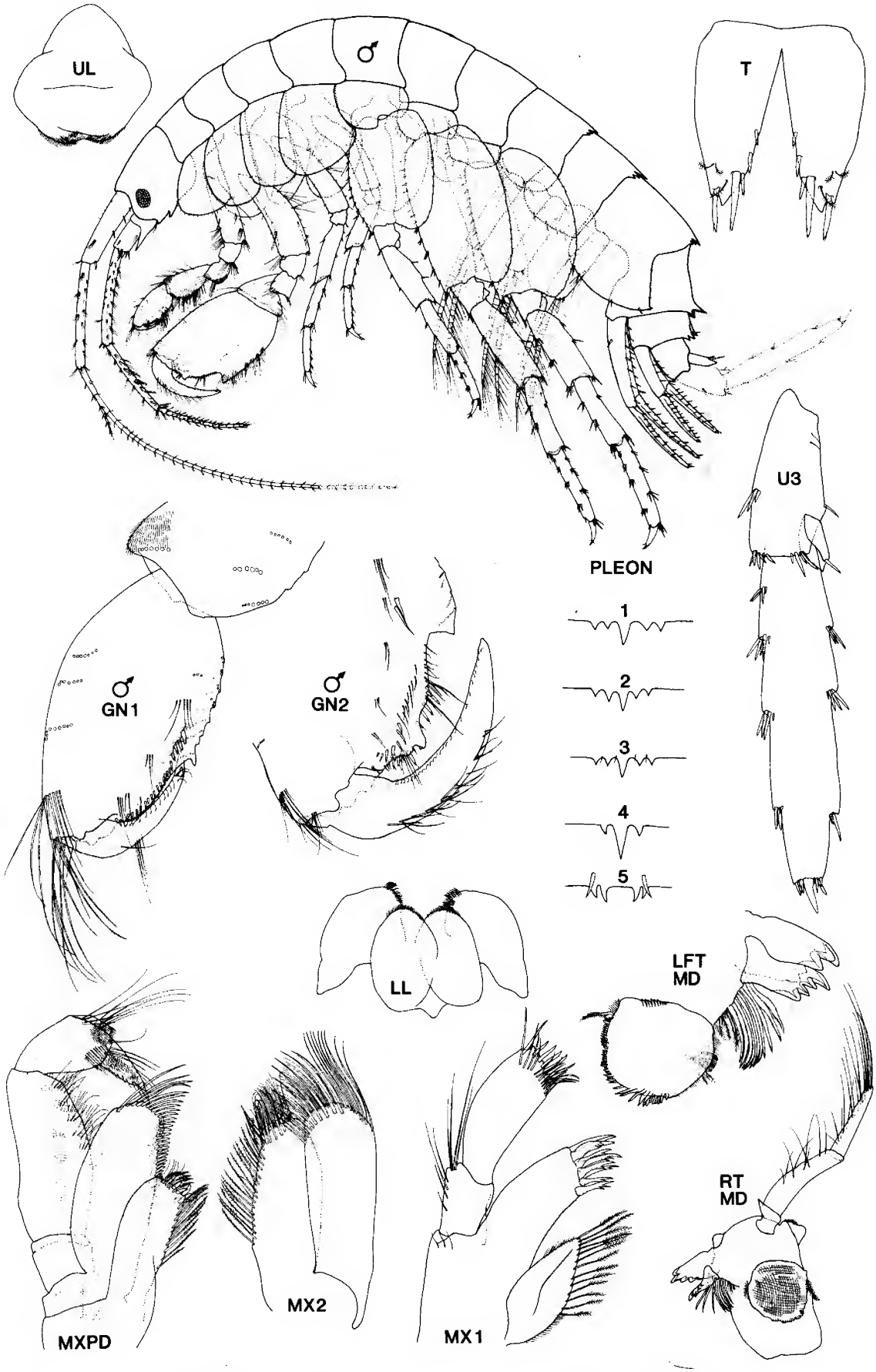

Fig. 14. ***Megamoera glacialis*****, new species. College Fiord (A110), Alaska. Male (12.0 mm).**

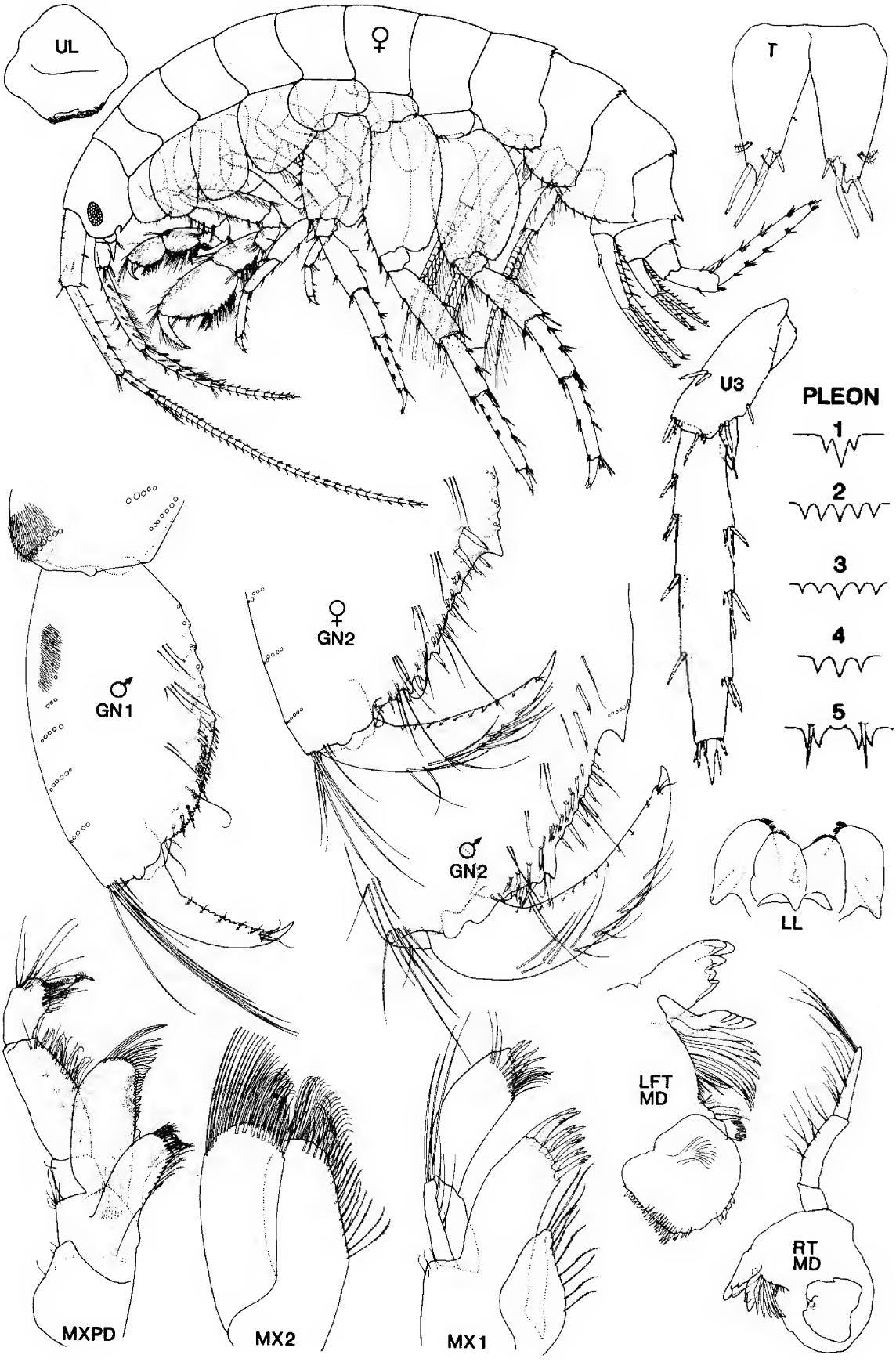

Fig. 15. ***Megamoera borealis*****, new species. College Fiord (A110), Alaska. Male (8.0 mm); female (9.5 mm).**

Anterior head lobe strongly rounded, lower margin with single tooth in female; inferior sinus a rounded notch. Eye ovate, medium. Antenna 1, peduncular segment 2 long-er than 1, segment 3 short; accessory flagellum 3-segmen-ted; flagellum slender, 30-35-segmented. Antenna 2, flagel-lum short, 10-segmented, subequal to peduncular segment 5.

Mandible, spine row with 10-12 blades; palp segment 3 moderately setose, setae in 4 clusters. Maxilla 1, inner plate with 10 marginal setae; palp segment 1 with 6-7 lateral setae. Maxilla 2, facial setae of inner plate strongly reduced (6-7) in distal, medial, closely submarginal row. Maxilliped, inner plate with 8-9 inner marginal setae; outer plate, inner marginal spines merging apically with 6 slender curved spines; dactyl basally stout, unguis curved.

Coxa 1 not expanded distally, anterior margin sharply rounded. Coxa 4 relatively broad, lower margin oblique, antero-distally broadly rounding. Gnathopod 1, basis antero-distally weakly setose; propod shorter than carpus, palm distinct, smooth, steeply oblique; dactyl regular, inner margin serrulate. Gnathopod 2, carpus, hind lobe medium, shallow, margin with 5-6 setal clusters; propod relatively large, subrectangular, palm oblique, slightly convex, weakly toothed, hind margin with 10-12 setal clusters; dactyl ordinary, unguis small, outer margin distally setose.

Peraeopods 3-4 unequal, dactyls medium. Peraeopods 5-7, bases regular, increasing posteriorly, hind margins finely crenulate; dactyls medium, length ~1/4 segment 6.

Pleon plates 1-3, hind corners weakly toothed, not produced. Uropods 1 & 2, rami elongate, strongly spinose, tips extending beyond peduncle of uropod 3. Uropod 3, outer ramus slender, margins with 3-4 clusters of slender spines; terminal segment distinct, length 3-4 X basal width.

Telson lobes stout, diverging distally, fused weakly basally; proximal notch medial; notch spines relatively long, slender; inner marginal spines virtually lacking.

Coxal gill 6 somewhat smaller than gill 5.

Male (8.0 mm) (Holotype). Gnathopod 1, propod short, sub-ovate, palm convex, very oblique, separated indistinctly from posterior margin by low tooth at palmar angle; dactyl with slight basal bulge; inner margin finely serrated. Gnatho-pod 2, carpus with short lower margin, weakly setose; propod medium, subrectangular, palm oblique, convex, inner marginal spines distad of low, irregular hinge tooth, postero-distal tooth acute; dactyl normal, outer margin strongly setose, tip with fused unguis.

Etymology. From the Latin "borealis" meaning northern, in reference to the northern Pacific distribution of the species.

Distributional ecology. Recorded from the Aleutian islands and southeastern Alaska to southern British Columbia, from the shore line subtidally to depths of 66 m.

Taxonomic commentary. *Megamoera borealis* is most closely related to *M. glacialis* in characters of the key and in the commentary (p. 27). It is also closely similar to *M. kodiakensis* (p. 37).

Megamoera mikulitschae (Gurjanova)
(Figs. 16, 17)

Melita mikulitschae Gurjanova, 1953: 225, fig. 10.—Kara-man, 1981: 41.

Material Examined.

ALASKA:

Aleutian Islands. Unimak I., P. Slattery Stns., June-Oct., 1982. - 1 male (30.0 mm) (**figured specimen**). CMN collections.

Diagnosis: Male (30. 0 mm) A large, robust species with large peraeopod bases. Pleon segments 1 & 2 with postero-dorsal tooth and 3 small lateral denticles on each side. Pleon 3, postero-dorsal tooth with 5 unequal denticles on each side. Urosome 1, postero-dorsal tooth with single denticle on each side. Urosome 2 with paired short teeth and very short spine on each side. Anterior head lobe shallow, inferior margin with prominent lobe; inferior antennal sinus a short notch. Antenna 1, peduncle 1 long, stout; peduncle 3 very short; accessory flagellum 6-segmented; flagellum slender, with 40+ segments. Antenna 2, peduncular segment 3 relatively long; flagellum short, little longer than peduncle 5, with about 16 segments.

Mandible, blades numerous (12+), slender; left lacinia 4-dentate; right lacinia 5 dentate; palp segments 2 & 3 strongly setose. Maxilla 1, inner plate, inner margin with 16+ setae; palp segment 1 with 8-10 lateral setae, outer segment broadening distally, apex rounded. Maxilla 2, facial setae reduced (8-10), distally closely submarginal; outer plate rounded distally. Maxilliped, inner plate medium, with 10-12 inner marginal setae; palp segment 2 medium broad; dactyl basally stout, medium short.

Coxa 1-3 medium deep, relatively broad, strongly overlapping, weakly notched behind. Coxa 4 largest and deepest, lower margin gently convex. Gnathopod 1 , basis antero-distally setose; propod relatively large, broadening distally, nearly as long as carpus, palm smooth, oblique, dactyl normal, inner margin finely setulose. Gnathopod 2, carpus medium, posterior lobe, distinct lower margin with 5-6 clusters of longish setae; propod large, subrectangular, hind margin strongly setose; palm oblique, hinge tooth small; dactyl stout, outer margin strongly setose.

Peraeopods 3 & 4 unequal; dactyls medium. Peraeopods 5-7, bases very large, broad, increasing posteriorly, lobate below; segment 4 slightly broadened; segment 6 shorter than segment 5, dactyls medium, ~1/4 length segment 6. Peraeopod 5 distinctly smallest.

Pleon plates 1 & 2, hind corners squared. Pleon 3, hind corner weakly produced, length of tooth about equal to its basal width. Uropods 1 & 2 very strong, rami elongate, regularly spined. Uropod 3, outer ramus slender, elongate, tapering, terminal segment various. Telson lobes stout, basally separated, proximal notch lateral, notch spines short; inner marginal spines lacking.

Coxal gills large, plate-like on peraeopods 2-5, some-what smaller on peraeopod 6.

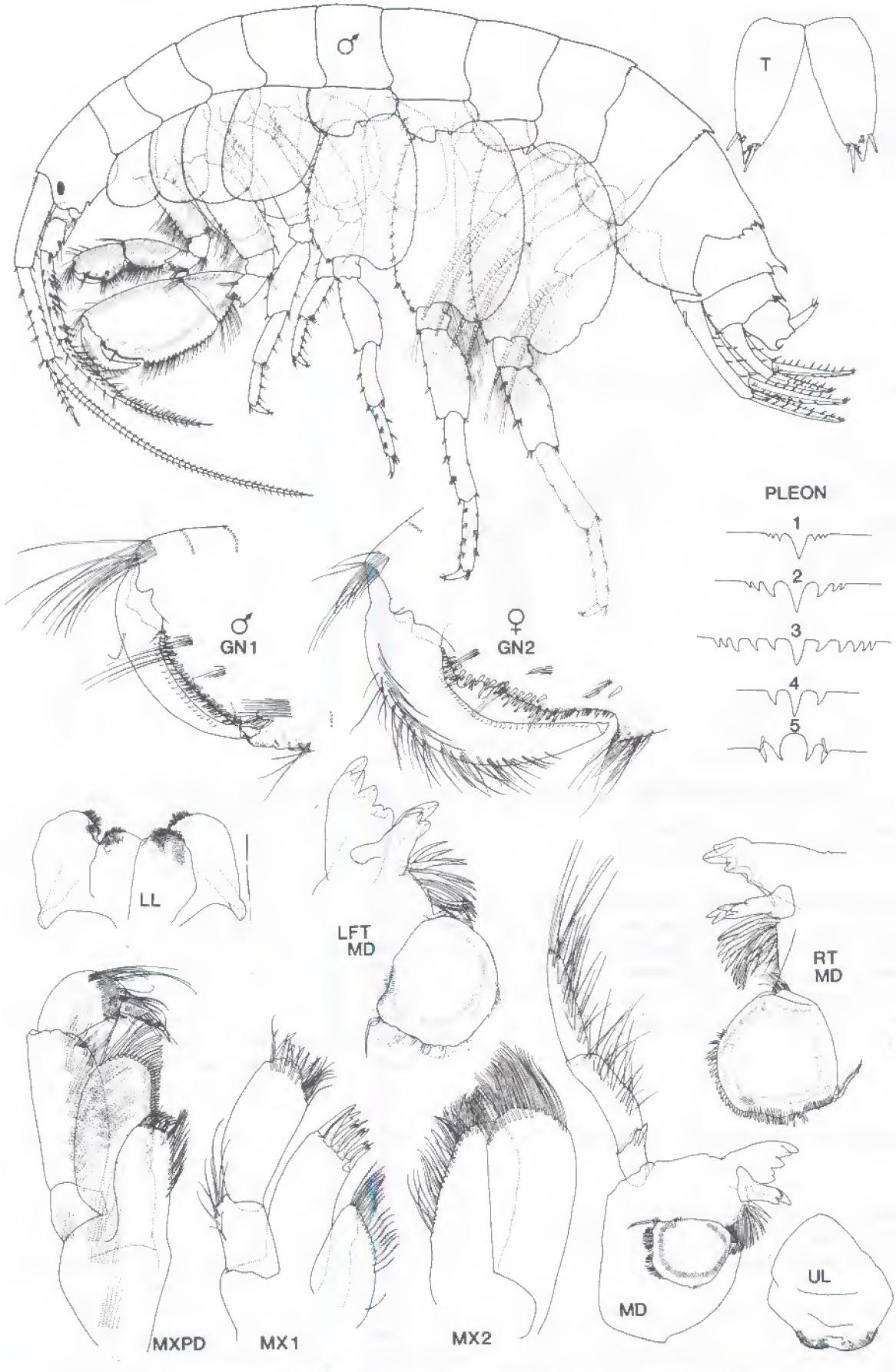

FIG. 16. ***Megamoera mikulitschae*** **(Gurjanova). Unimak I., Alaska. Male (30.0 mm).**

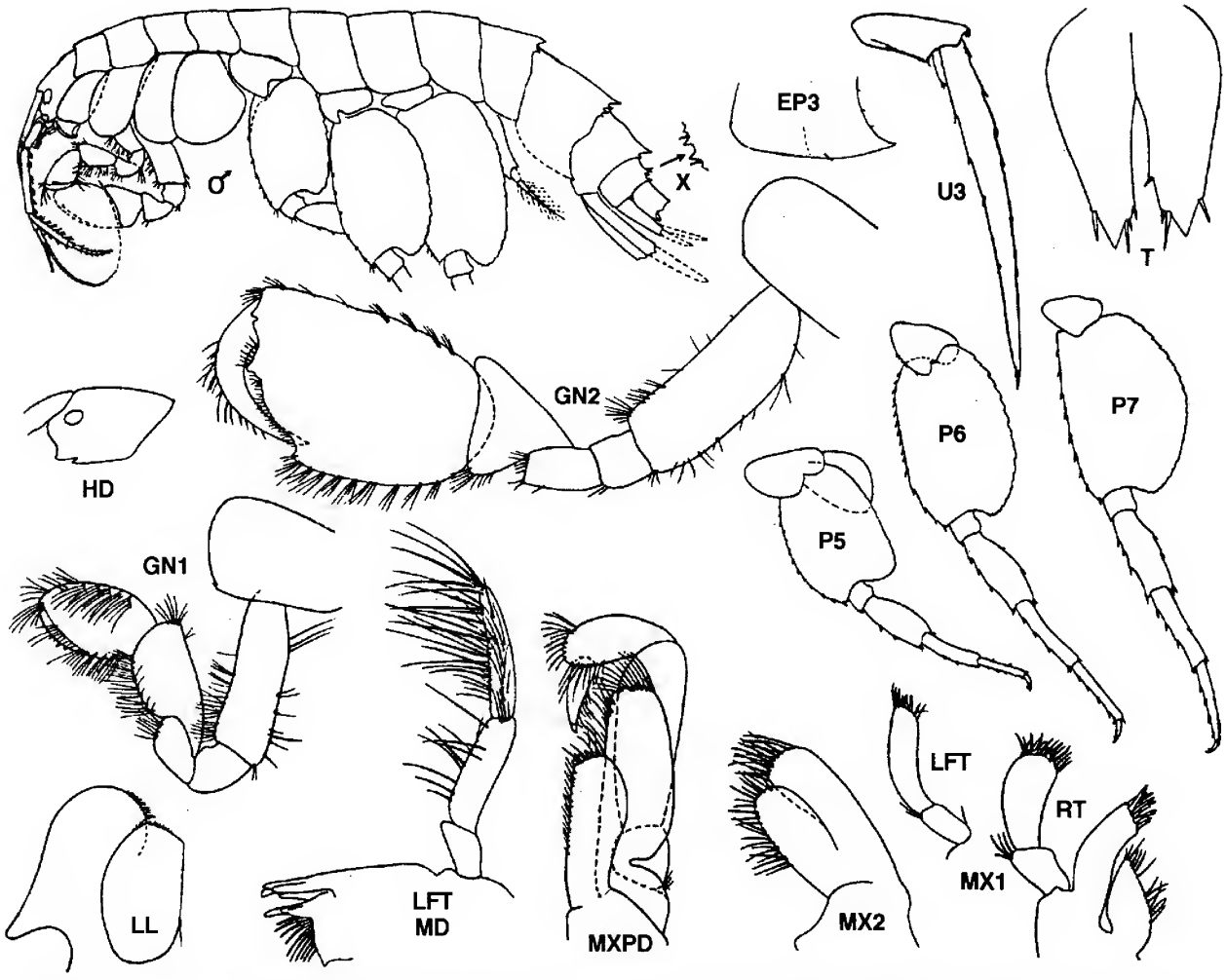

FIG. 17. ***Megamoera mikulitschae*** **(Gurjanova). Paramir I., Kurile Islands. Male (34.0 mm).**

Distribution: Unimak I., Okhotsk Sea, Bering Sea, Chukchi Sea, at littoral to sublittoral depths.

Taxonomic & distributional commentary: *Megamoera mikulitschae* is primitive and relatively isolated, but clusters closest to the *M. dentata* subgroup (p. 66). It is distinguished by its large size, strong inferior antennal head process, very large bases of peraeopods 5-7, weakly produced hind corner of pleon plate 3, and the slender, elongate, tapering uropod 3.

Megamoera kodiakensis (J. L. Barnard)
(Fig. 18)

Melita kodiakensis, J. L. Barnard, 1964: 315-335, figs. 1-12. —Barnard & Barnard, 1983: 665.—Austin, 1985: 610. *Abludomelita kodiakensis* Karaman, 1981: 40.

Diagnosis. Male (12.0 mm). Pleon segments 1 & 2 with centre tooth and 3-4 minute lateral denticles on each side; pleon 3 with centre tooth and 2-3 lateral denticles. Urosome 1 with central tooth and large single lateral tooth on both sides. Urosome 2 with 2 pairs of short teeth and single spines on each side. Anterior head lobe very shallow, lower margin with prominent accessory process; inferior antennal sinus a short notch. Eye medium, rounded. Antenna 1, peduncular segments short, accessory flagellum 3-segmented; flagellum ~25-segmented. Antenna 2, flagellum slender, much longer than peduncular segment 5, ~14-segmented.

Mandible, spine row with 10-12 blades; palp segment 3 very weakly setose (6 setae). Maxillae 1 and 2 and maxilliped not described, probably much as in *Megamoera glacialis*.

Coxae 1-3 medium, weakly notched below. Coxa 1 distally broadened, anterior margin rounded. Coxa 4 relatively narrow, lower margin gently convex. Gnathopod 1, basis, antero-distally very weakly setose; propod small, subrectangular, shorter than carpus, palm distinct, smooth, oblique; dactyl regular. Gnathopod 2, carpus, hind lobe narrow, small, with single apical seta; propod large, subrectangular, palm oblique, strongly toothed, hind margin with 8-9 clusters of short setae; dactyl regular, apex attenuated, setation of outer margin not indicated nor described.

Peraeopods 3-4 unequal, dactyls medium short. Peraeopods 5-7, bases regularly broadened, increasing posteriorly, hind margins crenulate; segment 4 slightly broadened; dactyls medium, each ~1/5 segment 6.

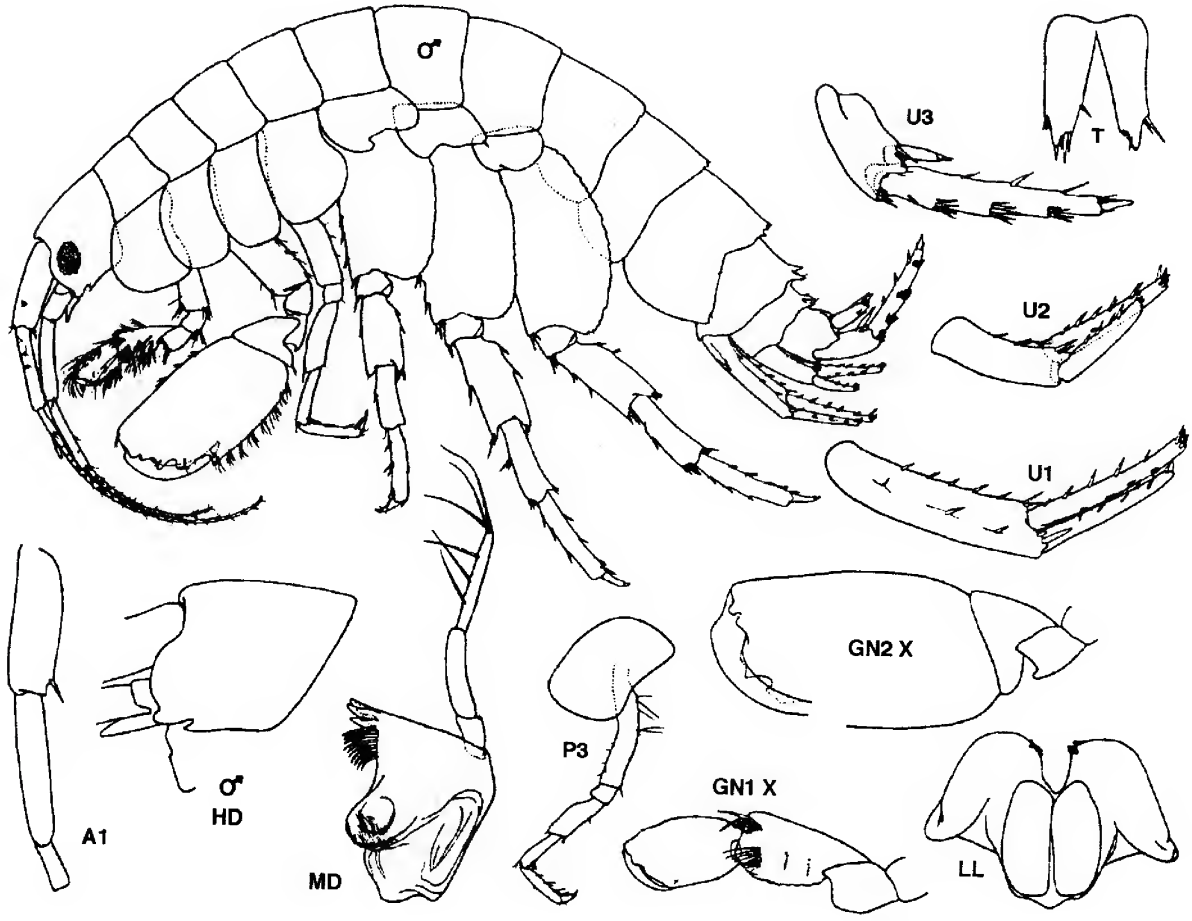

FIG. 18. ***Megamoera kodiakensis*** **(J. L. Barnard, 1964). Kodiak I., Alaska. Male (12.0 mm). (after Barnard, 1964).**

Pleon plates 1- 3, hind corners squared, not acuminate. Uropods 1 & 2, rami relatively short, tips of rami little exceeding peduncle of uropod 3; outer ramus distinctly the shorter in both. Uropod 3, inner ramus relatively long; outer ramus stout, relatively short, margins with 3-4 clusters of medium spines; terminal segment distinct, length 3-4 X basal width.

Telson lobes slender, diverging distally, fused slightly basally; proximal notch lateral, notch spines slender; 0-1 inner marginal spines.

Coxal gills undescribed.

Female unknown.

Distributional ecology. Known only from bathyal depths off Kodiak Island, Gulf of Alaska.

Taxonomic commentary. Barnard's original description of *"Melita" kodiakensis* is limited, but sufficiently complete to facilitate assignment of the species to the genus *Megamoera* as here defined. The species clusters relatively closely with *M. unimaki* and *M. glacialis*, within the *dentata* subgroup of *Megamoera.*

Melitoides Gurjanova
(Fig. 19)

Melitoides Gurjanova, 1934: 127, fig. 5.—Gurjanova, 1951: 752, fig. 522.—Barnard 1969a: 245.—Barnard & Barnard, 1983: 671.

Type species. *Melitoides makarovi* Gurjanova, 1934: 127 (monotypy).

Species. *Melitoides* (?)*valida* (Shoemaker, 1955).

Diagnosis. Pleon segments 1-2 smooth; pleon 3 moderately mid-dorsally toothed or humped. Urosome segments 1 & 2 mid-dorsally toothed. Head with single inferior antennal notch. Pigmented eyes lacking. Antennae regular.

Upper lip shallowly notched. Lower lip, outer lobes acute, directed laterally; inner lobes large. Mandible, spine row with few blades; left & right lacinia undescribed; palp segment 3 > segment 2; segment 1 elongate, lacking cusp. Maxilla 1, inner plate tall, with medial and apical setae, outer plate 7-spinose (Barnard & Barnard, 1983); palp segment 1 with shoulder setae; segment 2 slightly broadening. Maxilla

2, inner plate with closely submarginal setae only. Maxilliped, plates tall, medium; palp segment 2 columnar; dactyl strong.

Coxal plates 1-4 broad, deep. Coxa 1 distally expanded. Gnathopod 1 (male), carpus relatively long; propod relatively short, margins strongly setose; dactyl regular. Gnathopod 2 (male), carpus short, deep; propod large, subrectangular; palm strongly toothed; dactyl regular, outer margin probably strongly setose.

Coxa 6, anterior lobe not modified in female. Peraeopod 4 shorter than 3. Peraeopod 5 << peraeopods 6 & 7; bases (of all) very large, broad, weakly lobate; segments 4-6 slender, attenuated; dactyls medium long.

Pleon plates 1-3, hind corners weakly or not acuminate. Uropods 1 & 2 regular, rami linear. Uropod 3, inner ramus scale-like, outer ramus short, 1-segmented, not extending beyond rami of uropods 1 & 2. Telson lobes fused basally, apices sub-tuncate, with single spines.

Coxal gills and brood plates undescribed.

Taxonomic and distributional commentary. This genus is a marginal member of the *Abludomelita* group of genera, differing in a number of character states, including the total reduction of the terminal segment of uropod 3, and the basally fused lobes of the telson.

The type species, *Melitoides makarovi,* is known only from the eastern Siberian and Bering Seas, to Iterup I., in sublittoral depths (27 m).

Melitoides makarovi Gurjanova
(Fig. 19)

Melitoides makarovi Gurjanova, 1934: 127, fig. 5.—Gurjanova, 1936: 39, figs. 1, 2.—Gurjanova, 1951: 753, fig. 522.—Barnard, 1969a: 245.—Barnard & Barnard, 1983: 671.

Material Examined. None from Bering Sea and other regional localities.

Diagnosis. Male (30.0 mm). With the characters of the genus. Pigmented eyes lacking. Anterior head lobe sharply rounded. Antenna 1, flagellum ~40-segmented. Antenna 2, flagellum ~15-segmented.

Maxilliped, inner plate not exceeding slender palp segment 2. Coxae 2-4 deeper than broad. Gnathopod 2, propod, anterior and posterior margins subparallel, palm nearly vertical. Peraeopods 5-7, bases very broad. Peraeopods 6 & 7 elongate; postero-distal lobes of bases squared or acute behind.

Pleon 3 rounded behind. Uropod 3, outer ramus, margins with 2-3 clusters of short spines only. Telson lobes appearing fused basally, apices each with single short spine.

Female undescribed.

Taxonomic and distributional commentary. Recorded from the eastern Siberian Sea to the Bering Sea, in depths to 27 m. *M. makarovi* may overlap distributionally with *M. valida* (Shoemaker), with species of *Quasimelita,* and with *Megamoera mikulitschae* (Gurjanova).

Melitoides (?) ***valida*** (Shoemaker)
(Fig. 20)

Melita valida Shoemaker, 1955: 50, fig. 15.—Barnard, 1958: 62.—Barnard & Barnard, 1983: 666.
Abludomelita valida (Shoemaker) Karaman, 1981: 40.

Material examined. None from the study region.

Diagnosis. Male (to 30.0 mm) (details from Shoemaker, 1955). Pleon segments 2 & 3 very finely toothed middorsally. Urosome segments 1 & 2 weakly toothed posterodorsally. Inferior antennal sinus shallow, cusp small, regressed. Eye small, indistinct. Antenna 1 large; peduncular segment 3 relatively long; accessory flagellum 3-segmented; flagellum elongate (40+ segments). Antenna 2, peduncle 3 long, gland cone long; flagellum longer than peduncle 5, 13-segmented.

Mandible, spine row with many blades (12+?); right lacinia with bifid apex; palp segment 3 > 2, strongly setose; Maxilla 1, inner plate triangular, inner margin setose;palp segment 1 with 3 groups of lateral setae; segment 2 widening distally. Maxilla 2 , inner plate slightly the shorter (facial setae undescribed). Maxilliped, outer plate tall, slightly exceeding slightly broadened palp 2, apex with slender curved graduated spines only; dactyl of palp medium strong.

Coxae 1-4 large, deep, increasing posteriorly,weakly or not cuspate behind. Coxa 1 broadened distally. Gnathopod 1 (male), basis moderately setose antero-distally; carpus slender, shallowly lobate; propod shorter. Gnathopod 2, carpus short, deep; propod large, widening distally; palm oblique, convex, strongly toothed; dactyl large, outer margin smooth (no setae shown by Shoemaker, loc. cit.).

Peraeopod 4 slightly smaller than 3, both with relatively short segments 5 & 6; dactyls medium. Peraeopod 5 distinctly smaller than 6 & 7; bases large, medium broad, hind lobes medium; distal segments and dactyls medium long.

Pleon plates 1 rounded behind; pleon plate 2 with small hind tooth; pleon 3 moderately produced, acute (Shoemaker figure). Uropods 1 & 2 regular, rami lanceolate, reaching beyond peduncle of uropod 3. Uropod 3, inner ramus scale-like, apex acute; outer ramus elongate, narrow, margins with 5 clusters of spines, terminal segment indistinct.

Telson lobes basally fused, diverging, notches subapical, with single spine, proximal notch lateral; Coxal gills not described.

Distribution. Known only from Pt. Barrow, Alaska.

Taxonomic commentary. This species is tentatively assigned to genus *Melitoides* because of its overall similarity to *M. makarovi* in morphology, size, and Arctic distribution.

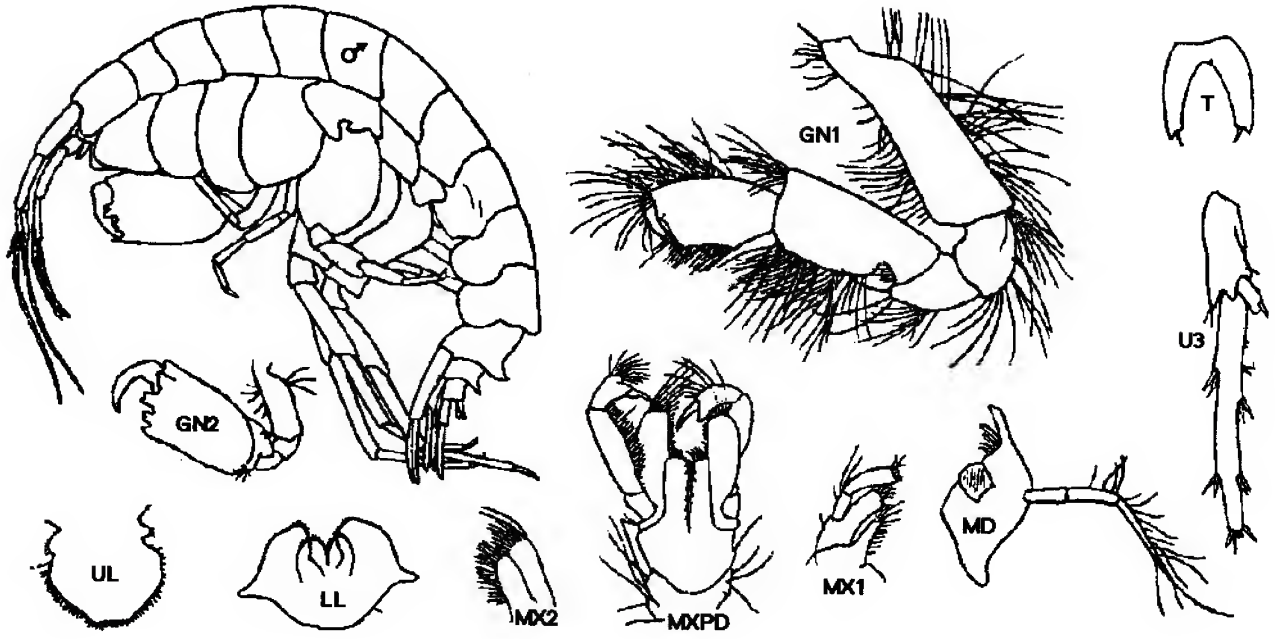

FIG. 19. *Melitoides makarovi* Gurjanova, 1934. Male (19.0 mm). Eastern Siberian & Bering Seas.

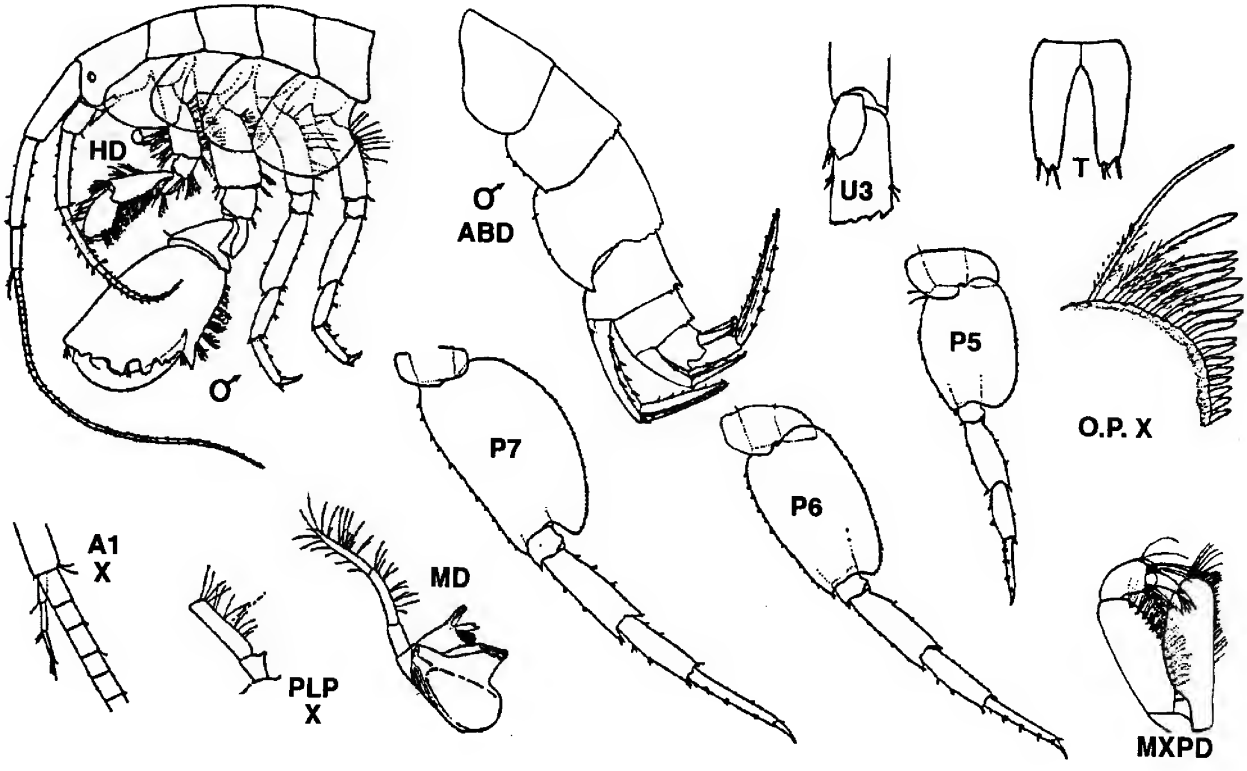

FIG. 20. *Melitoides* (?) *valida* (Shoemaker, 1955). Male (28.0 mm). Pt. Barrow, Alaska. (after Shoemaker, 1955).

Quasimelita, new genus

Melita Stebbing, 1906: 421 (part).—Karaman, 1981: 41 (part).—Barnard & Barnard, 1983: 664 (part).

Type species: *Melita quadrispinosa* Vosseler, 1889.

Species: *Quasimelita formosa* (Murdoch,1885); *Q. abyssorum* (Stephensen, 1944).

Diagnosis: Combining character states of *Melita* and *Abludomelita* but with distinctive features, especially of mouthparts and gnathopods. Pleon weakly toothed to smooth dorsally. Urosome segment 1 with dorsal tooth. Urosome 2 with dorsal teeth (usually paired) and usually single spines on each side. Anterior head lobe rounded; inferior antennal sinus broadly incised. Antenna 1, peduncular segment 3 short.

Upper lip incised below. Lower lip, inner lobes large. Mandible, spine row short; palp weak, segment 1 lacking distal process; left lacinia 4-dentate, right lacinia 3-dentate; incisor irregularly dentate. Maxilla 1, inner plate triangular, weakly setose medially; outer plate with 9 apical spines; palp segment 1 with lateral setae; segment 2 apically spinose and setose. Maxilla 2, inner plate, with few facial setae, submarginally positioned. Maxilliped, inner plate tall; outer plate broad, apical margin setose; palp segment 2 very stout, dactyl short.

Coxae 1-4 medium to shallow and may decrease in size and depth posteriorly. Coxae 1-3, lower margin rounded or squared, hind corner lacking cusp. Coxa 1 slightly broadened distally. Coxa 4 small, posterior proximal excavation weak or lacking. Gnathopods 1 & 2 conspicuously sexually dimorphic. Gnathopod 1, propod shorter than carpus, margins strongly setose; palm and dactyl short. Gnathopod 2 (male), carpus large, with broadly setose lower margin; propod large, broadening distally, palm irregularly toothed, postero-distal process large; dactyl with outer marginal setae.

Peraeopods 3 & 4 unequal; segment 4 stout; dactyls well developed. Peraeopods 5-7, bases deep, variously narrowed, hind lobes reduced, small; dactyls well developed.

Pleon segment 3, hind corner produced. Pleopods elongate; peduncles strongly setose laterally. Uropods 1 & 2 regular; distal peduncular spine weak; rami lanceolate, margins spinose. Uropod 3, outer ramus strong, 2-segmented. Telson lobes weakly (or not) fused basally, marginal notches closely subapical. Coxal gills 2-5 large, saclike; gill 6 small.

Etymology: From the Latin "*quasi*" meaning "resembling" and the root stem *"Melita"*.

Taxonomic and Distributional commentary. This genus combines a number of character states that are transitional between *Megamoera* and *Melitoides*. Three species are recognized: *Quasimelita quadrispinosa* and *Q. formosa* are littoral to sublittoral arctic and subarctic forms, and *Q. abyssorum* is abyssal in the North Atlantic region.

Quasimelita quadrispinosa (Vosseler)
(Figs. 21, 22)

Melita quadrispinosa Vosseler, 1889: 157, figs. 15-24.—Stebbing, 1906: 422.—Gurjanova, 1951: 751, fig. 520.—Karaman, 1981: 41.—Barnard & Barnard, 1983: 666.

Material Examined.
ALASKA:
Southeastern Alaska, ELB Stn. A83 (Cordova Bay), in silt and gravel at LW level, June 30, 1961 - 1 female br. I (9.0 mm) **(figured)**, CMN collections, Ottawa.

Diagnosis. Female (9.0 mm). Urosome segment 1 with strong postero-dorsal tooth. Urosome 2 dorsal teeth short, spines slender. Anterior head lobe large, rounded, lower margin smooth. Eye small, round. Antenna 1, peduncle 3 short; accessory flagellum 6-segmented; flagellum ~20-segmented. Antenna 2, peduncular segments 3-5, posterior margins with strong setal clusters; flagellum short, 10-segmented.

Upper lip incised. Mandible, spine row short, with 6-7 blades; palp segment 3 short, weakly setose (6-7 setae). Maxilla 1, inner plate with 6-7 marginal setae; palp segment 1 with 5-6 lateral setae. Maxilla 2, facial setae of inner plate very reduced (4-5 setae), distally medial, closely submarginal. Maxilliped, inner plate with 6 widely spaced inner marginal setae; outer plate, inner marginal spines merging apically with 7-8 slender curved seta-like spines; palp segment 2 very broad, massive; dactyl short, basally stout.

Coxa 1 slightly expanded distally, anterior margin rounded. Coxa 4, lower margin nearly straight. Gnathopod 1, basis, antero-distal margin setose throughout; propod relatively shallow, shorter than carpus, distally narrowing to short, nearly vertical, smooth palm that is armed distally on both margins with numerous closely set small spines; dactyl short, basally stout. Gnathopod 2, carpus large, hind lobe shallow, lower margin with 8-10 clusters of longish setae; propod large, subrectangular, longer than carpus; palm oblique, irregular, weakly toothed; dactyl stout, unguis acute, outer margin lined with single row of 8-9 setae.

Peraeopods 3-4, segments 5 & 6 with posterior marginal setal clusters; dactyls medium,length ~1/3 segment 6. Peraeopods 5-7, bases large, increasingly broad posteriorly, hind margins weakly crenulate; segment 4 little broadened; dactyls medium, slender. Coxa 6, anterior lobe unmodified.

Pleon plates 1 & 2, hind corners acuminate; pleon 3, hind corner moderately produced, slightly upturned, acute. Uropods 1 & 2 stout, rami lanceolate, regularly spinose, tips extending well beyond peduncle of uropod 3. Uropod 3, outer ramus stout, tapering distally, margins with 4-5 clusters of medium spines; terminal segment distinct, length 3-4 X basal width.

Telson lobes fused basally, diverging distally, marginal notches small, proximal notch lateral, each with medium spine, inner and outer margins each with single spines.

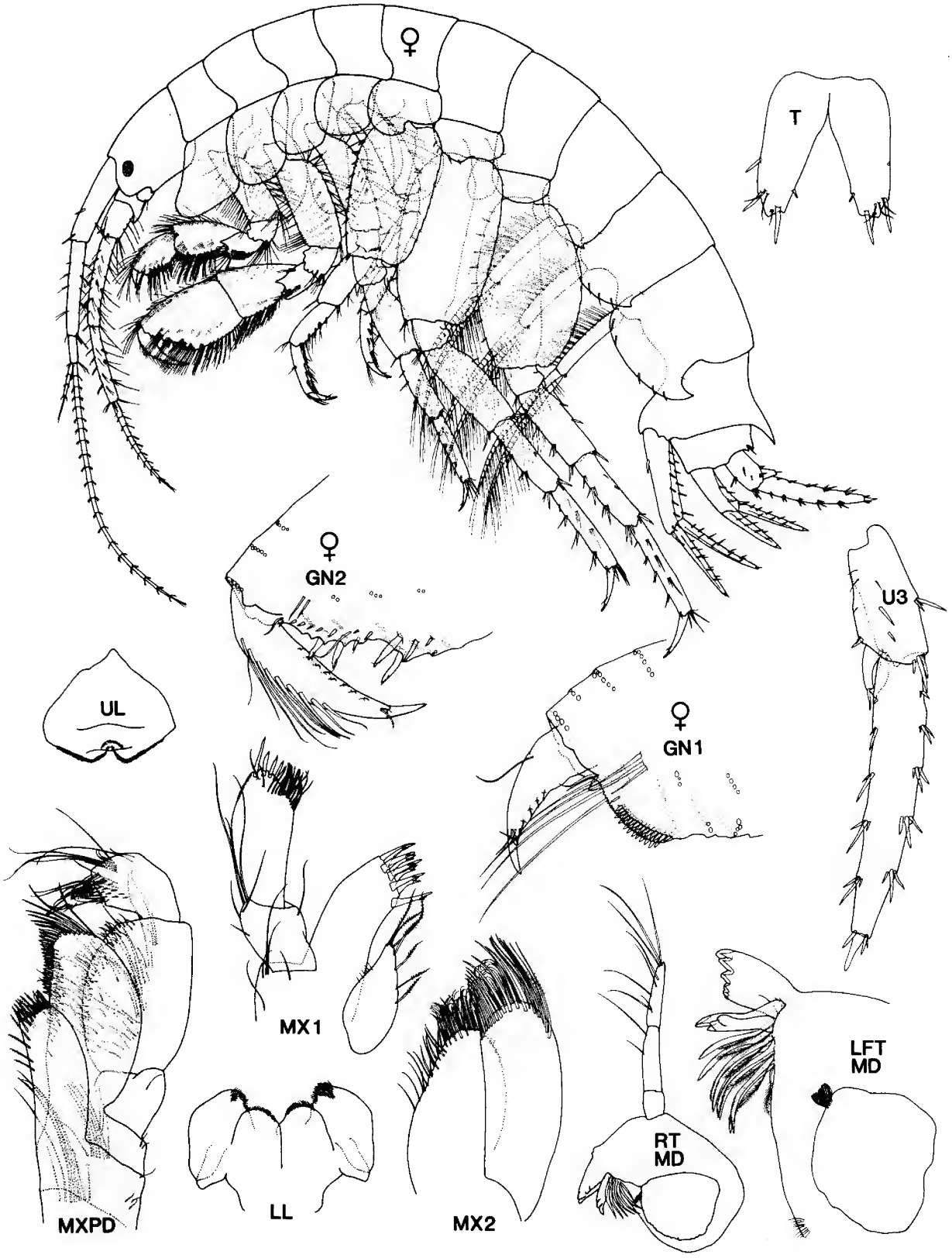

FIG. 21. ***Quadrimelita quadrispinosa*** **(Vosseler). Cordova Bay, Southeastern Alaska. Female (9.0 mm).**

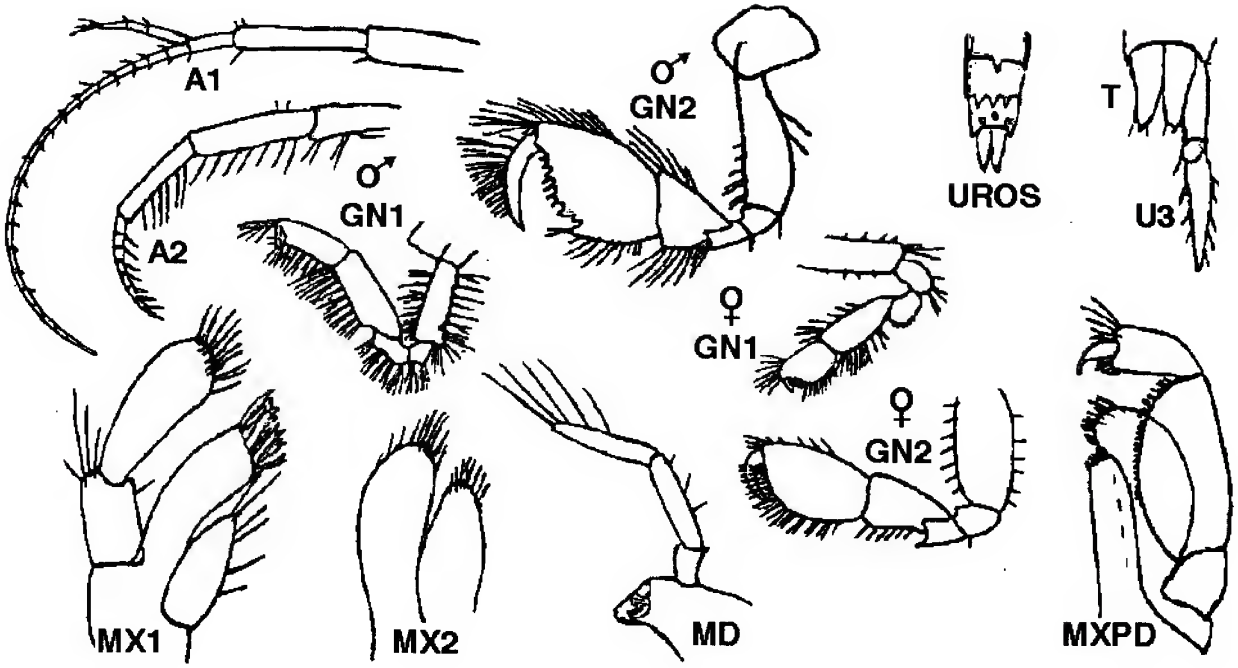

Fig. 22. ***Quasimelita quadrispinosa*** **(Vosseler). Barents Sea. Male (11.5 mm); female (10.0 mm). (after Vosseler, 1889; Gurjanova, 1951).**

Coxal gill 6 much smaller than coxal gill 5.

Male (11.5 mm)(after Gurjanova, loc cit.). Gnathopod 1, propod and carpus slender, elongate, upper and lower margins subparallel, lower margin strongly setose; palm short, nearly vertical, dactyl short. Gnathopod 2, hind margin of carpus with 6-7 setal clusters; propod large, distally broadening, palm oblique, irregular, length ~ hind margin; outer margin of dactyl lined with long setae.

Distributional ecology: Recorded from the Barents, Chukchi and Bering Seas, at littoral and sublittoral depths.

Taxonomic commentary. Pleon segments 2 & 3 may appear smooth since the posterior dorsal teeth are very small.

Quasimelita formosa (Murdoch)
(Fig. 23)

Melita formosa Murdoch, 1885: 520.—Stebbing, 1906: 427.—Gurjanova, 1951: 748, fig. 517.—Shoemaker, 1955: 50.—Karaman, 1981: 40.—Barnard & Barnard, 1983: 665.

Material examined. Specimens from Resolute Bay, Arctic Canada, in CMN collections. Type from Arctic Alaska.

Taxonomic commentary: A large slender species, length to 30 mm (Shoemaker, 1955). Description and figures are meagre. The principal diagnositic features are as follows: Pleon segments 2 & 3 with single mid-dorsal tooth.. Urosome segments with mid-dorsal and adjacent teeth; urosome 2 with paired small dorso-lateral teeth. Peraeopods 5-7, coxae small, shallow; bases narrow, rectilinear, posterior margins strongly serrate, hind lobes small, acute.

Uropod 3, outer ramus, terminal segment small. The species may merit subgeneric status because of its unique morphological features.

Distributional ecology. Recorded by Shoemaker (1955) commonly at Pt. Barrow Alaska. Also known from northern Japan. Widely distributed across the Siberian and Canadian Arctic, in depths to 480 m.

Quasimelita abyssorum **(Stephensen)**
(Fig. 24)

Melita abyssorum Stephensen, 1944: 21, figs. 13-14.—Barnard, 1958: 61.—Barnard & Barnard, 1983: 664.
Abludomelita abyssorum Karaman, 1981: 40.

Taxonomic commentary. *Quasimelita abyssorum* conforms with most of the major diagnostic characters of the genus. It differs from the sublittoral arctic species (above)in its elongate antenna 1, elongate gnathopod carpi, strong baso-facial spine on the peduncle of uropod 1, and the relatively large coxa 4. Apparently, only the female has been described, so the degree of sexual dimorphism of the gnathopods is unknown. .

Distributional ecology: Known only from the type locality in the North Atlantic off Greenland, 2258 m. depth.

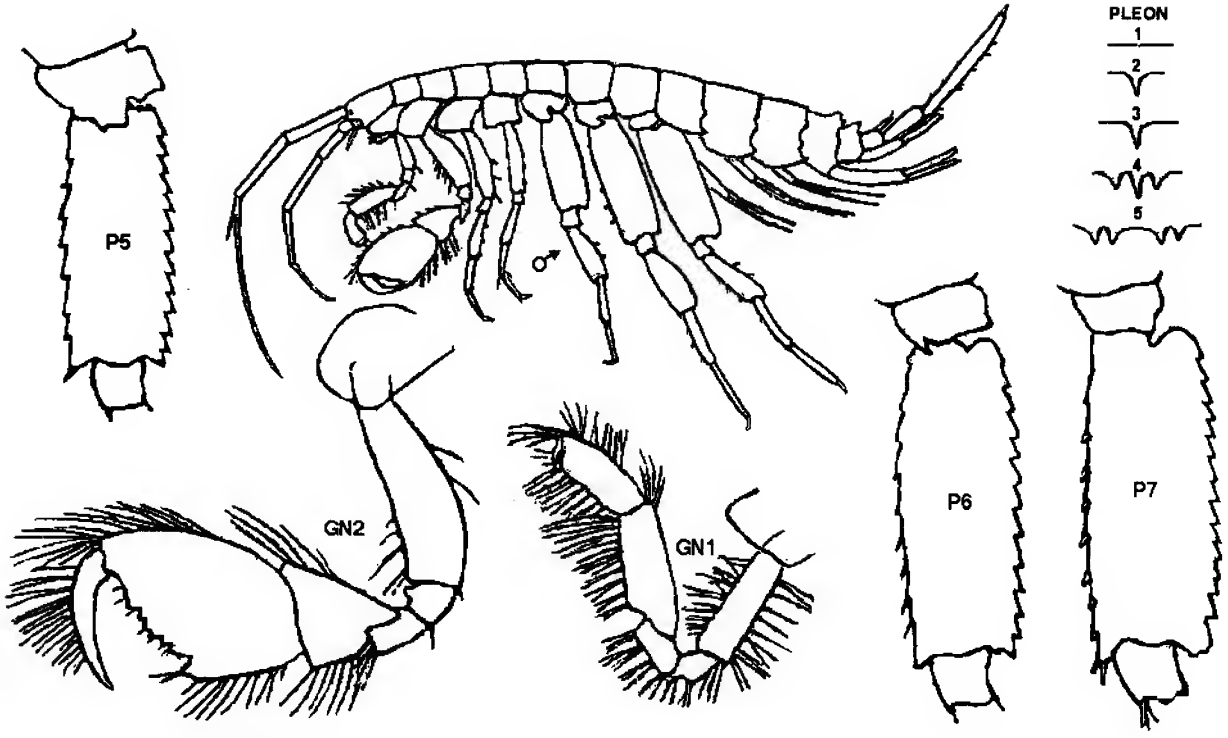

FIG. 23. *Quasimelita formosa* (Murdoch). Pt. Barrow, Alaska. Male (21.0 mm) (after Stephensen, 1940).

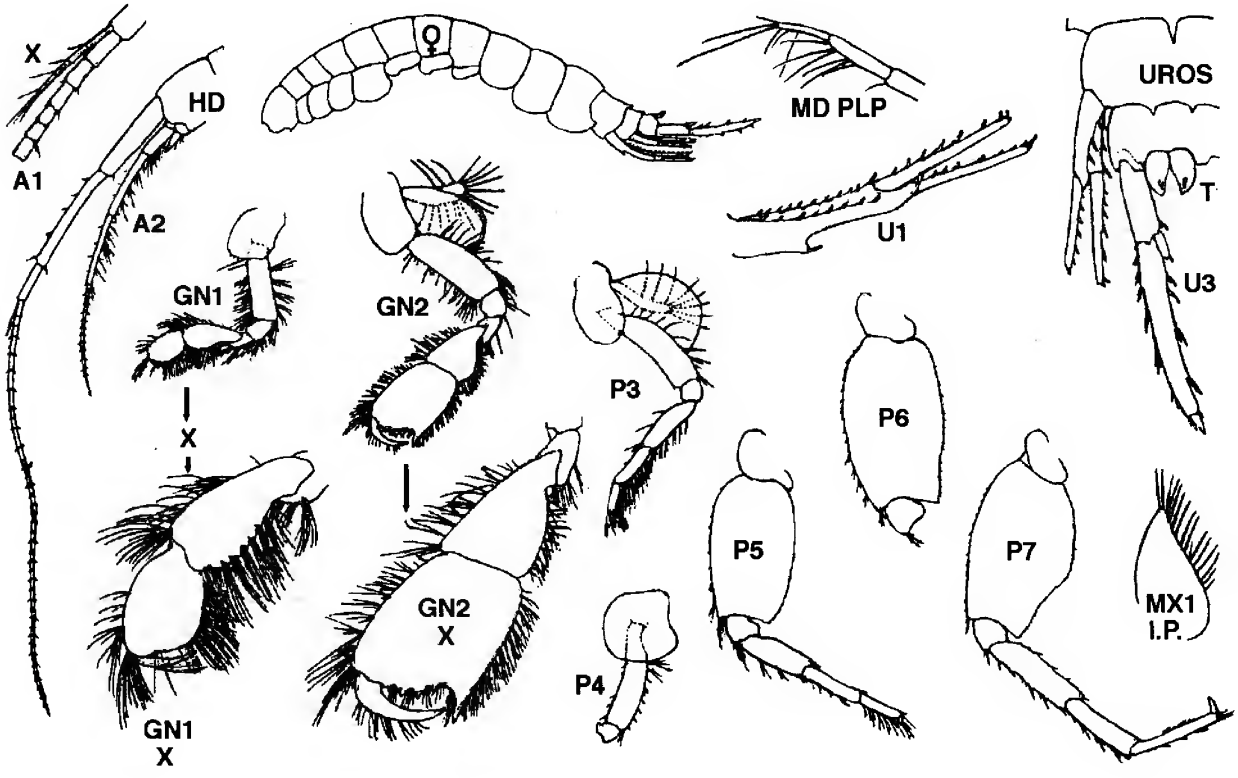

FIG. 24. *Qaasimelita abyssorum* Stephensen, 1944. North Atlantic, 2258 m. Female (25.0 mm). (after Stephensen, 1944b).

Desdimelita, new genus

Melita Barnard, 1969: 245 (partim). Barnard & Karaman, 1983: 664 (part).
Abludomelita Karaman, 1981: 40 (part).

Type species. *Melita desdichada* J. L. Barnard 1962, present designation.

Species. *Desdimelita californica* (Alderman, 1936); *Desdimelita microdentata*, new species; *Desdimelita microphalma*, new species; *Desdimelita barnardi*, new species.

Diagnosis. Male: Pleon smooth above. Urosome 1 usually with single dorsal tooth. Urosome 2 with paired dorsal teeth and single spine. Anterior head lobe broadly rounded, inferior antennal notch sharply incised. Antenna regular, not elongate.

Upper lip shallowly notched. Lower lip broad, processes normal; inner lobes well developed. Mandible, accessory blades few (6-10); left lacinia 4-dentate, right 3-dentate; palp segment 1 with medial acute process; segment 3 not longer than 2. Maxilla 1, inner plate acuminate, medial margin setose; outer plate with 9 apical spines; palp segment 1 with few lateral setae, outer segment broadened distally. Maxilla 2, inner plate with submarginal facial row, and distal oblique facial row of setae; outer plate with angled outer shoulder. Maxilliped, inner and outer plates relatively short; palp segment 2 columnar; dactyl medium.

Coxae 1-4 medium deep, rounded below, lacking posterior notch. Coxa 1 usually broadened distally. Gnathopod 1 weakly sexually dimorphic; palm oblique, margins finely spinose, dactyl normal. Gnathopod 2 (male), carpus short deep; propod, palm with hinge tooth variously developed; dactyl strong, with few (or none) outer marginal setae. Per-aeopod 5-7, bases large, regular; segment 4 of peraeopod 6 larger than in peraeopod 7; dactyls short to medium.

Pleon plate 3 produced acutely. Uropods 1 & 2, rami normally spinose, linear. Uropod 3, inner ramus very small, terminal segment or outer ramus small..

Telson lobes normal, slightly fused basally, proximal notch lateral; inner margins with weak spines.

Coxal gills 2-5 large; gill 6 variously smaller.
Female: Gnathopod 1, propod short, palm nearly vertical. Gnathopod 2, carpus medium short, hind margin setoso; propod short, palm smooth. Coxa 6, anterior lobe normal or bifid (in *D. transmelita*).

Taxonomic & Distributional Commentary. The genus *Desdimelita* is apparently confined to the North American Pacific coast. However, in the edentate pleon segments, and slender carpus and propod of gnathopod 1 (male), members of *Desdimelita* are similar to Asiatic Pacific members of the genus *Melita*.

Desdimelita appears transitional to genus *Melita* also in reduction of mouthpart setation, the palmar tooth of gnathopod 2 (male), and the terminal segment of the outer ramus of uropod 3. In the female of one species, the anterior lobe of coxa 6 is bifid, but not otherwise modified or hook-like.

Desdimelita desdichada (J. L. Barnard)
(Figs. 25, 26)

Melita desdichada J. L. Barnard, 1962: 110, fig. 22.—Barnard & Barnard, 1983: 664.—Austin, 1985: 610.—Staude, 1987: 384 (+ key).
Abludomelita desdichada Karaman, 1981: 40.

Material Examined. A total of 120 specimens at 28 stations, as follows:
ALASKA:
Southeastern Alaska, ELB Stn. A83 (Cordova Bay), June 30, 1961 - 1 male, 1 female.

BRITISH COLUMBIA:
North-central coast, ELB Stn. N1 (Open Bight), Aug. 3, 1959 - 1 male; Stn. N23b (Pendrell Sound), July 23, 1959 - 1 female.
ELB Stns., 1964: 3 localities - 1 female, 2 juveniles.
South-central coast, ELB Stn. EB8 (Burrard Inlet), 40 m. mud, June 16, 1976 - 1 female ov.; additional station, P. O'Rourke coll. - 1 male, 1 female;
ELB Stns., 1977-78: 7 localities in Burrard Inlet, 10-60 m. - 30 males, females, and juveniles.
Vancouver Island, north end, ELB Stns., 1959: V20 (Brown Bay) - 1 male (9.0 mm) (**figured**), 1 female, 2 juveniles; V3 (Nahwitti Bar) - 10 mostly male specimens.
Vancouver Island, south end, ELB Stns., 1970: P712 (David I., Trevor Channel), intertidal, bedrock, boulders, shelly sand, July 21 - 1 female ov. (5.5 mm) (**figured**).
ELB Stns.,1975: P12 (off Brady's Beach), 34 m.,muddy sand July 29 - 1 male, 1 female; P12 (Keeha Bay), 4-12 m., sand, Aug. 2 - 1 male, 6 juveniles; 6 additional localities, Berkley Sound region, intertidal - 24 m., bedrock, muddy sand, gravel - 14 male, female, and juvenile specimens.
ELB Stns., 1977: 3 stations off Brady's Beach, 10-30 m., sand, May-June - 6 males, 10 females.
K.E.Conlan coll., Saanich Inlet, 1976 - 25 specimens.
G. W. O'Connell Stn., off McCauley Pt., Victoria, 1977 - 1 male, 1 female.

Diagnosis. Male (9.0 mm). Urosome 1, postero-dorsal tooth single, strong. Urosome 2, postero dorsal paired teeth strong. Eye medium, rounded; inferior antennal notch narrow. Antenna 1, peduncle with 2-3 posterior marginal spines; peduncular segment 2 >segment 1; flagellum ~25 segments; accessory flagellum 5-segmented. Antenna 2, flagellum 10-segmented, segments nearly bare.

Mandible, spine row with 10-12 slender blades; palp segment 3 weakly setose. Maxilla 1, inner plate with 11 marginal setae; palp segment 1 with 3-4 lateral setae. Maxilla 2, inner plate with distal transverse facial row of 4-5 setae.

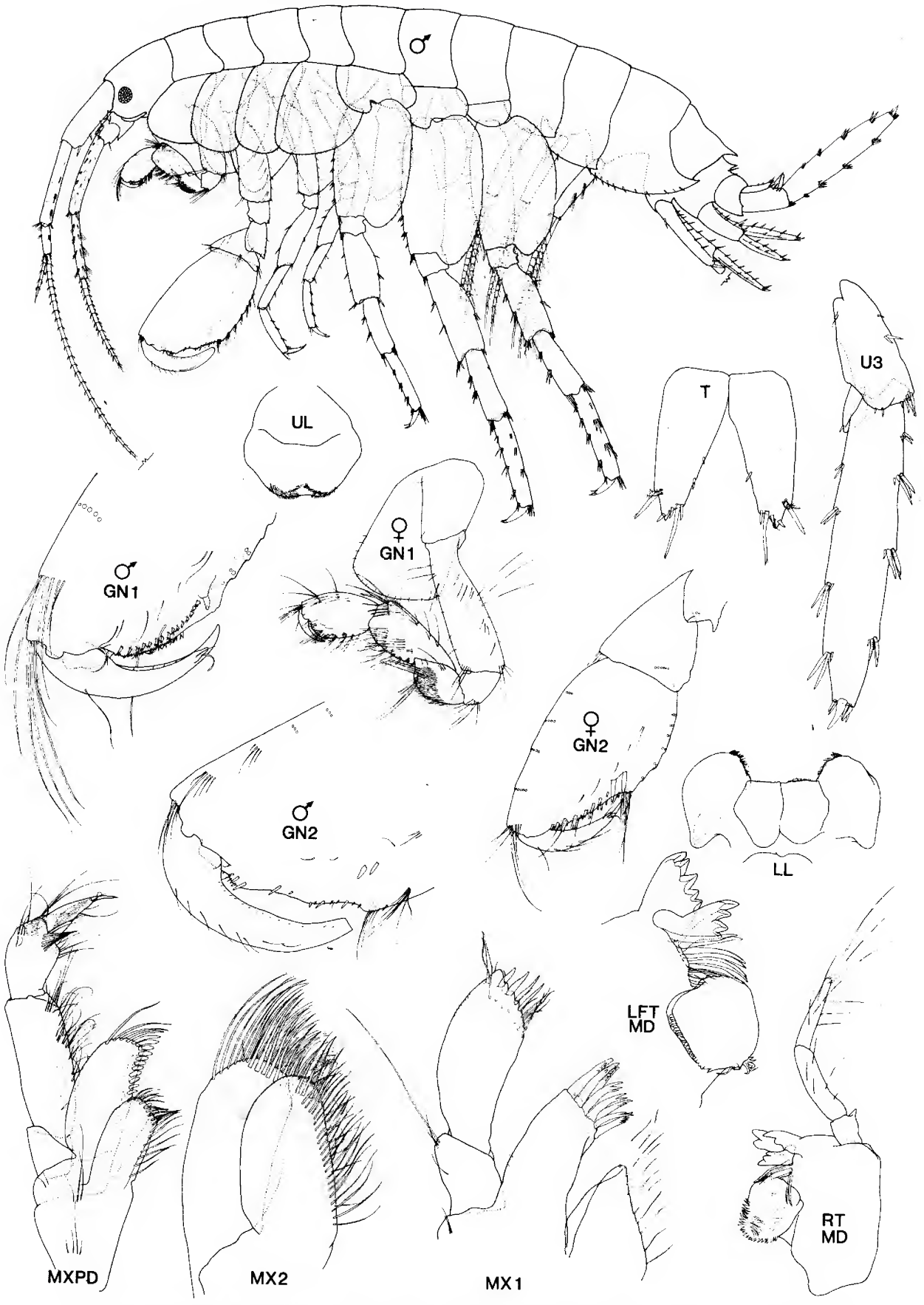

FIG. 25. ***Desdimelita desdichada*** **(J. L. Barnard). Brown Bay, Vancouver I. Male (9.0 mm); female (5.5 mm). Hanes I. (P712), Trevor Channel, B. C.**

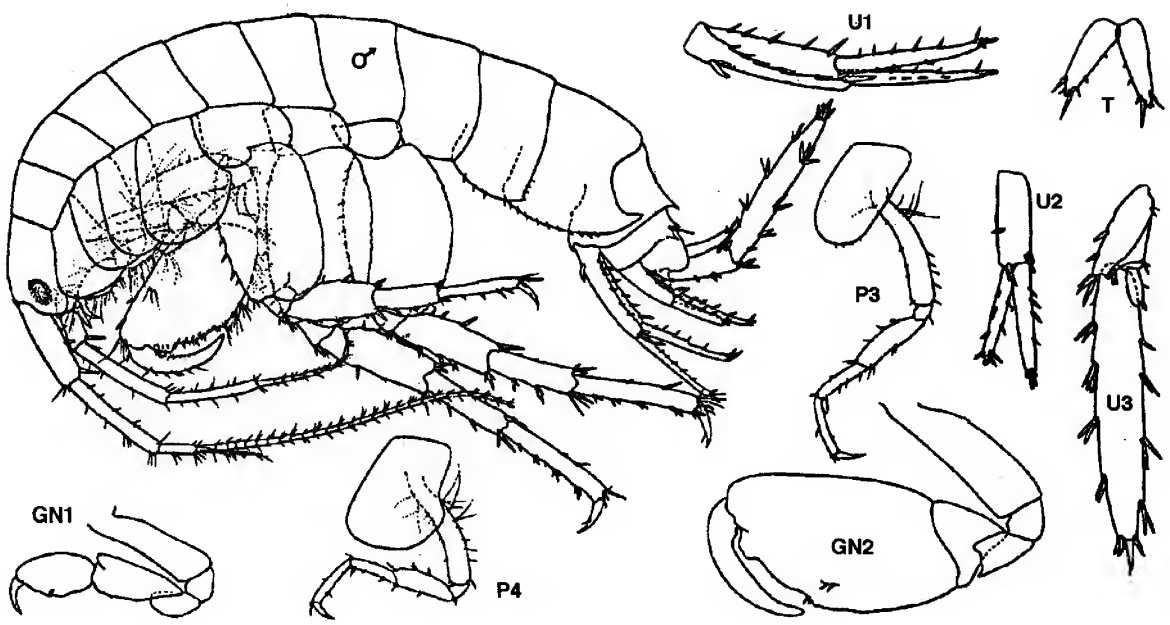

FIG. 26. ***Desdimelita desdichada*** **(J. L. Barnard). Central California coast. Male (7.0 mm). (after Barnard, 1969).**

KEY TO SPECIES OF *DESDIMELITA*

1. Urosome 2, postero-dorsal teeth small, inconspicuous; gnathopod 2 (male), palm of propod smooth, lacking hinge tooth; maxilla 2, inner plate lacking distal oblique row of facial setae . . . . . 2.

—Urosome 2, postero-dorsal teeth strong, conspicuous; gnathopod 2 (male), palm with hinge tooth variously developed; maxilla 2, inner plate with short distal oblique row of facial setae . . . . . 3.

2. Eye very small, round; coxa 6 (female), anterior lobe simple . . . . . *D. microphthalma*, n. sp. (p. 48)

—Eye of normal size; coxa 6 (female); anterior lobe bifid . . . . . *D. transmelita* n. sp. (p. 48)

3. Urosome 1 with 3 or 5 postero-dorsal teeth or cusps; gnathopod 1 (male) propod elongate . . . . *D. californica* (Alderman) (p. 44)

—Urosome 1 with single postero-dorsal tooth; gnathopod 1 (male) propod normal . . . . . 4.

4. Telson lobes each with 2 long apical spines; peraeopods 3-7, dactyls long. *D.desdichada* (Barn.)(p. 40)

—Telson lobes with 0-1 long apical spines; peraeopod dactyls short (<1/4 segment 6) . . . . . 5.

5. Uropod 3, outer ramus elongate, straight, lateral margins with 6-7 clusters of spines; uropod 1, rami with 3 marginal spines; antenna 1, accessory flagellum 4-segmented . . . . . *D. barnardi* n. sp. (p. 46)

—Uropod 3, outer ramus ordinary, margins with 4 spine clusters; uropod 1, rami with 6 marginal spines; antenna 1, accessory flagellum 6-segmented . . . . . *D. microdentata* n. sp. (p. 44)

Maxilliped, inner plate with 8 marginal setae; outer plate short, 2/3 palp segment 2.

Coxa 1 medium broad distally. Coxa 4 nearly as broad as deep. Gnathopod 1, propod distinctly shorter than carpus, palm gently convex. Gnathopod 2, carpus, hind lobe narrow, deep; propod much longer than deep, palm oblique, with weak hinge tooth; dactyl heavy, lined with several outer marginal setae.

Peraeopods 3 & 4, dactyls relatively long, about 1/3 segment 6. Peraeopods 5-7, basis regular, subsimilar in

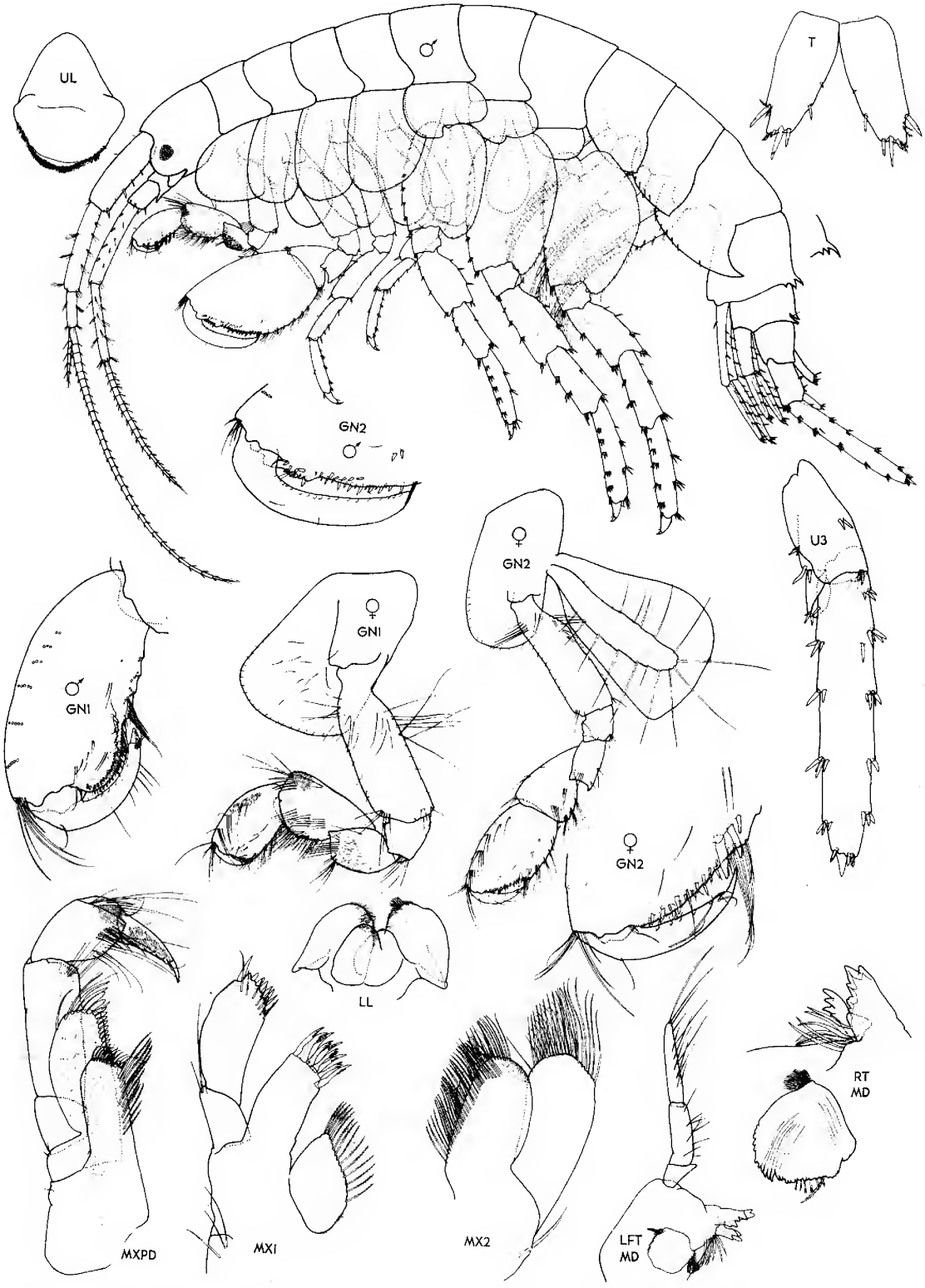

FIG. 27. *Desdimelita californica* (Alderman). Prince of Wales I., southeastern Alaska. Male (10.0 mm); female 7.0 mm).

form, dactyls relatively long,~ 1/4 segment 6. Peraeopod 5 segment 6 normal, not broadened.

Pleon segment 2, hind corner weakly acuminate; pleon 3, lower margin with 10+ short spines. Uropod 1, peduncle relatively short; rami with 4-6 marginal spines. Uropod 3, outer ramus with 4 groups of marginal spines; terminal segment medium.

Telson, subapical spines long, slender, inner margins with 1-2 small spines.

Coxal gills large, deep, subacute below; gill 6 smaller.

Female ov (7.0 mm). Gnathopod 1, propod short, deep, palm nearly vertidal. Gnathopod 2, palm oblique, nearly straight, strongly spinose, dactyl with outer marginal setae. Coxa 6, anterior lobe simple, not bifid.

Distributional Ecology. From Southeastern Alaska to Pt. Conception, California, on soft sediments at LW & subtidal depths, to ~120 m.

Taxonomic commentary. *Desdimelita desdichada* shows mainly plesiomorphic character states and is a primitive species of the genus.

Desdimelita californica (Alderman)
(Fig. 27)

Melita californica Alderman, 1936: 60, figs. 26-30.—Barnard & Barnard, 1983: 664.—Austin, 1985: 610.—Staude, 1987: 373 (key), 384.
Abludomelita californica (Alderman) Karaman, 1981: 40.

Material Examined. More than 1000 specimens in 53 lots, as follows:
SE Alaska, ELB Stns., 1961: A6 (East of Pt. Marsh, Prince Wales I.), intertidal, May 31 - 1 male (11.0 mm) **(figured)**, female ov. (7.0 mm)**(figured),** ~200 additional specimens; 20 other localities, intertidal to 37 m., May-July - ~280 specimens. ELB Stns., July, 1980: 7 localitieS (S4B5, S5B1, S5B2, S5B8, S11B1, S11B2, S11B4), intertidal, boulders, slate, gravel - 78 male, female, juvenile specimens.

BRITISH COLUMBIA:
Queen Charlotte Islands, ELB Stns., July-August, 1957: 11 localities (incl. E21, W4a, W9), intertidal - ~75 specimens. North-central mainland, ELB Stn. N1 (Open Bight), intertidal Aug. 3, 1959 - 1 specimen. ELB Stns., July-August, 1964: 6 localities, intertidal - ~200 specimens. C. Levings Stn. L., 29 m, Swanson Bay, April, 1973 - 3 specimens.
South-central mainland, ELB Stn. V8 (off Spanish Banks, Burrard Inlet, 3-8 m, July 4, 1978 - 1 specimen.
Vancouver Island, north end, ELB Stns., June-August, 1959: 9 localities (incl. O1, O11, V19), intertidal - 26 specimens. Vancouver Island, south end, ELB Stns., July-August, 1955: 8 localities, intertidal - 47 specimens. ELB Stns., July-August, 1970: 11 localities (incl. P702, P709, P710, P714, P715, P718, P719, P721), intertidal - ~ 100 specimens. ELB Stns., June-July, 1976: 4 localities intertidal - 25 specimens. ELB Stns., May-June, 1977: 3 localities - 30 specimens.

WASHINGTON:
ELB Stns., July, 1966: 3 localities (W34, W35, W36) (Clallam Co.), intertidal - 10 specimens. R. M. O'Clair St. 7400 04 (Friday Harbor), 1976 - 4 specimens.

OREGON:
ELB Stn. W58 (Seal Rocks), intertidal, bedrock, sand, Aug. 13, 1966 - 2 specimens.

Diagnosis. Male (10.0 mm). Urosome segment 1, posterodorsal tooth slender, with pair of smaller denticles on each side. Urosome 2, postero-dorsal paired teeth strong, each encompassing single spine. Eye relatively small, rounded; inferior antennal notch relatively broad. Antenna 1, peduncle with 3-4 posterior marginal spines; segment 2 ~ segment 1; flagellum ~30 segments; accessory flagellum 5-segmented. Antenna 2, flagellum 15-segmented, segments weakly setose.

Mandible, spine row with 7-8 slender blades; palp segment 3 moderately strongly setose. Maxilla 1, inner plate with 12-14 marginal setae; palp segment 1 with 2 lateral setae. Maxilla 2, inner plate with distal transverse facial row of 6 setae. Maxilliped, inner plate with 10-11 inner marginal setae; outer plate short, 2/3 palp segment 2.

Coxa 1 medium, distally broad, nearly as wide as deep. Coxa 4 relatively narrow, deep. Gnathopod 1, propod slender, a little shorter than carpus, palm strongly oblique, strongly convex, finely spinose. Gnathopod 2, carpus, hind lobe narrow, deep; propod a little longer than deep, palm oblique, slightly convex, with low hinge tooth; dactyl heavy, lacking outer marginal setae, inner margin lined with several minute setules.

Peraeopods 3 & 4 distinctly unequal; dactyls short, length about 1/4 segment 6. Peraeopods 5-7, bases somewhat unlike; dactyls short,~<1/5 segment 6. Peraeopod 5, basis distinctly shorter, relatively broad; segment 6 slightly broadened.

Pleon segment 2 hind corner squared; pleon 3, lower margin with ~6 short spines. Uropod 1, peduncle relatively long; rami with 3-5 marginal spines. Uropod 3, outer ramus with 4-5 groups of marginal spines; terminal segment very short.

Telson, subapical spines short, inner margins with 2 unequal small spines.

Coxal gills large, saclike, rounded below; gill 6 a little smaller, narrower.
Female ov (7.0 mm). Gnathopod 1, carpus relatively short, deep; propod short, deep, palm nearly vertical. Gnathopod 2, propod relatively small; palm oblique, slightly convex, unevenly spinose; dactyl with 2-3 outer marginal setae. Coxa 6, anterior lobe simple, not bifid.

Distributional Ecology. Aleutian Island chain south to central California, in cobbles and fine sediment, from LW to deep subtidal levels.

Taxonomic commentary. *Desdimelita californica* exhibits mainly plesiomorphic character states.

Desdimelita microdentata, new species
(Fig. 28)

Material Examined. About 500 specimens in 70 lots, as follows:
ALASKA:
Southeastern Alaska, ELB Stns., May-June, 1961: 13 local-

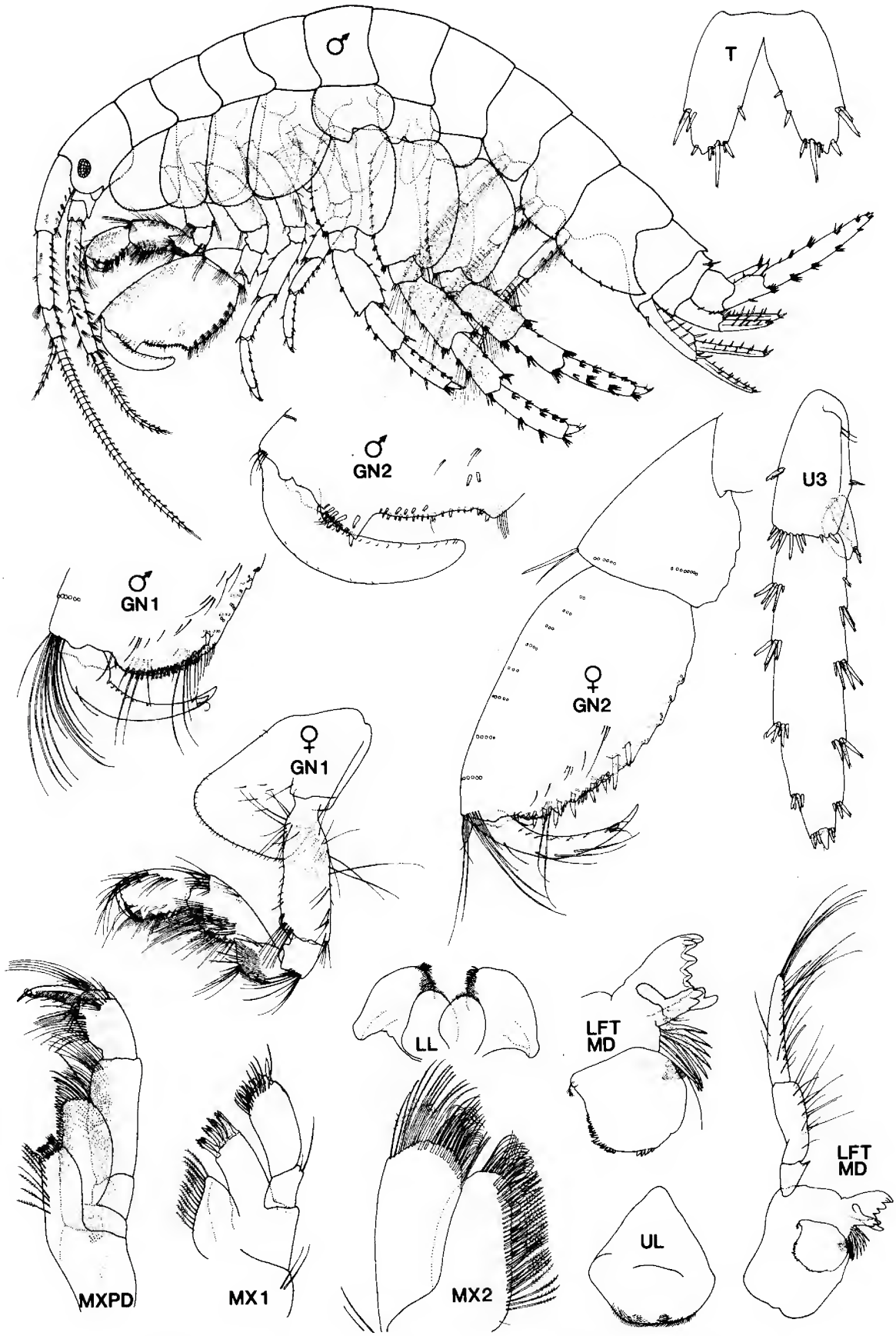

FIG. 28. ***Desdimelita microdentata,*** **new species. Kalaloch Beach (W24), WA. Male (11.0 mm); female (9.0 mm).**

ities (A2, A8, A15, A19, A20, A23, A57, A68, A71, A75, A80, A83, A129) - 93 males, females, juveniles. ELB Stns., July, 1980: 6 localities (S5B1, S5B2, S11B1, S11B2, S11B4), intertidal, slate, gravel, - ~100 males, females, juveniles.

BRITISH COLUMBIA:
Queen Charlotte Islands, ELB Stns., July-August, 1957: E17, E25, N2a, H14, W1 - 40 males, females.
North-central mainland, ELB Stns., July, 1964: H1, H10, H35, H40, H41 - 30 male, female, and juvenile specimens. Vancouver Island, south end, ELB Stns., August, 1955: F2, F4, F6a, P6a, P6c - 5 males, 4 females; ELB Stns., July-August, 1970: P702, P707, P714, P715, P716, P719, P721 - 65 male, female and juvenile specimens. ELB Stns., July-August, 1975: P5d, P18b, P20a, P22, P29a - ~200 males, females, juveniles. ELB Stns, June-July, 1976: B3, B7, B13, B20, B27, intertidal to 30 m. - 55 specimens. ELB Stn. B11b (Wickaninnish Bay), intertidal, May 23, 1977 - 1 male, 1 female.
J. F. L. Carl Stn., Bazan Bay, July 19, 1955 - 3 males, 3 females. D. V. Ellis Stn., Cadboro Bay, Oct. 23, 1965 - 2 males, 2 females. K. E. Conlan Stns., Saanich Inlet, 1976 - 1 juvenile. R. M. O'Clair Stns., 1976: Galiano Island, June 20, 1976 - 3 males, 2 females; Port McNeil, June 26 - 2 females.

WASHINGTON:
ELB Stns., 1966: W24 (Kalaloch Beach), intertidal, fine dark sand, July 23 - 1 male (11.0 mm) **Holotype**, 1 female ov. (9.0 mm) **Allotype**, ~100 male and female **Paratypes**; 4 other localities (W22, W34, W35, W40) - 16 male and female specimens. CMN collections, Ottawa.

OREGON:
ELB Stns., August, 1966: 5 localities (W50, W53, W57, W58, W63) - 23 male, female, and juvenile specimens.

Diagnosis. Male (11.0 mm). Urosome 1, postero-dorsal tooth very small, single. Urosome 2, postero-dorsal paired teeth medium, each encompassing single slender spine. Head, eye medium, subovate; inferior antennal notch small, narrow. Antenna 1, peduncle with 5-6 posterior marginal spines; segment 2 ~ segment 1; flagellum with 30+ segments; accessory flagellum 6-segmented. Antenna 2, flagellum ~12-segmented, segments moderately setose.

Mandible, spine row with 10-11 slender blades; palp segment 3 regularly strongly setose. Maxilla 1, inner plate with 12-14 marginal setae; palp segment 1 with 1-2 lateral setae. Maxilla 2, inner plate with distal oblique facial row of 3-4 setae. Maxilliped, inner plate with 6-8 inner marginal setae; outer plate short, 2/3 palp segment 2.

Coxa 1 medium, distally broad, nearly as wide as deep, broadly rounding anteriorly. Coxa 4 medium, deeper than broad. Gnathopod 1, propod slightly broadening distally, a little shorter than carpus; palm moderately oblique, gently convex, lined with numerous fine spines. Gnathopod 2, carpus, hind lobe very narrow, deep; propod very large, a little longer than deep, palm oblique, slightly convex, with strong hinge tooth; dactyl attenuated distally, lacking outer marginal setae, inner margin proximally with minute setules. Peraeopods 3 larger than 4; dactyls short, length ~ 1/4 segment 6. Peraeopods 5-7, bases broad, slightly dissimilar; dactyls short, ~<1/5 segment 6. Peraeopod 5, segment 6 slightly broadened.

Pleon segment 2, hind corner slightly acuminate; pleon 3, lower margin with ~6 short spines. Uropod 1, peduncle relatively short; rami with 5-6 marginal spines. Uropod 3, outer ramus relatively broad, with 4-5 groups of marginal spines; terminal segment very short.

Telson, subapical spines mainly short with 1 longer spine at inner notch, inner margins with 1-2 unequal short spines.

Coxal gills large, saclike, narrowing and rounded; gill 6 very much smaller and narrower.

Female ov. (9.0 mm). Gnathopod 1, carpus regular, deep; propod regular, palm gently convex, nearly vertical. Gnathopod 2, propod regular, palm oblique, unevenly convex, unevenly spinose; dactyl with 2-3 long outer marginal setae and several inner marginal setules. Coxa 6, anterior lobe simple, shallow, not bifid.

Etymology. From the Greek root "mikros" (small), and the Latin "dens - dentis" (tooth), referring to the relatively small postero-dorsal teeth on urosome segments 1 & 2.

Distributional Ecology. From southeastern Alaska to central Oregon, in depths from the low intertidal to ~35 m.

Taxonomic commentary. *Desdimelita microdentata* also demonstrates mainly plesiomorphic character states, and is most closely related to the primitive *desdichada-californica* complex of species.

Desdimelita barnardi, new species.
(Fig. 29)

Material Examined.
BRITISH COLUMBIA:
Vancouver I, south end, ELB Stn. P5d (Taylor I., Trevor Channel), intertidal, under stone, July, 1975 - male (8.0 mm) **Holotype** (single specimen). CMN collections, Ottawa.

Diagnosis. Male (8.0 mm). Urosome 1 virtually smooth mid-dorsally. Urosome 2, postero-dorsal paired teeth strong, each encompassing single short spine. Eye relatively large, rounded; inferior antennal notch medium. Antenna 1, peduncular segment 1 with 4-5 posterior marginal spines; segment 2 ~ segment 1; flagellum with ~25 segments; accessory flagellum 4-segmented. Antenna 2, flagellum ~12-segmented, segments sparsely setose.

Mandible, spine row with 8-9 slender blades; palp segment 3 regularly moderately setose. Maxilla 1, inner plate with 12 marginal setae; palp segment 1 with 1-2 lateral setae. Maxilla 2, inner plate lacking distinct distal oblique facial row of setae. Maxilliped, inner plate with ~12 inner marginal setae; outer plate short, 2/3 palp segment 2.

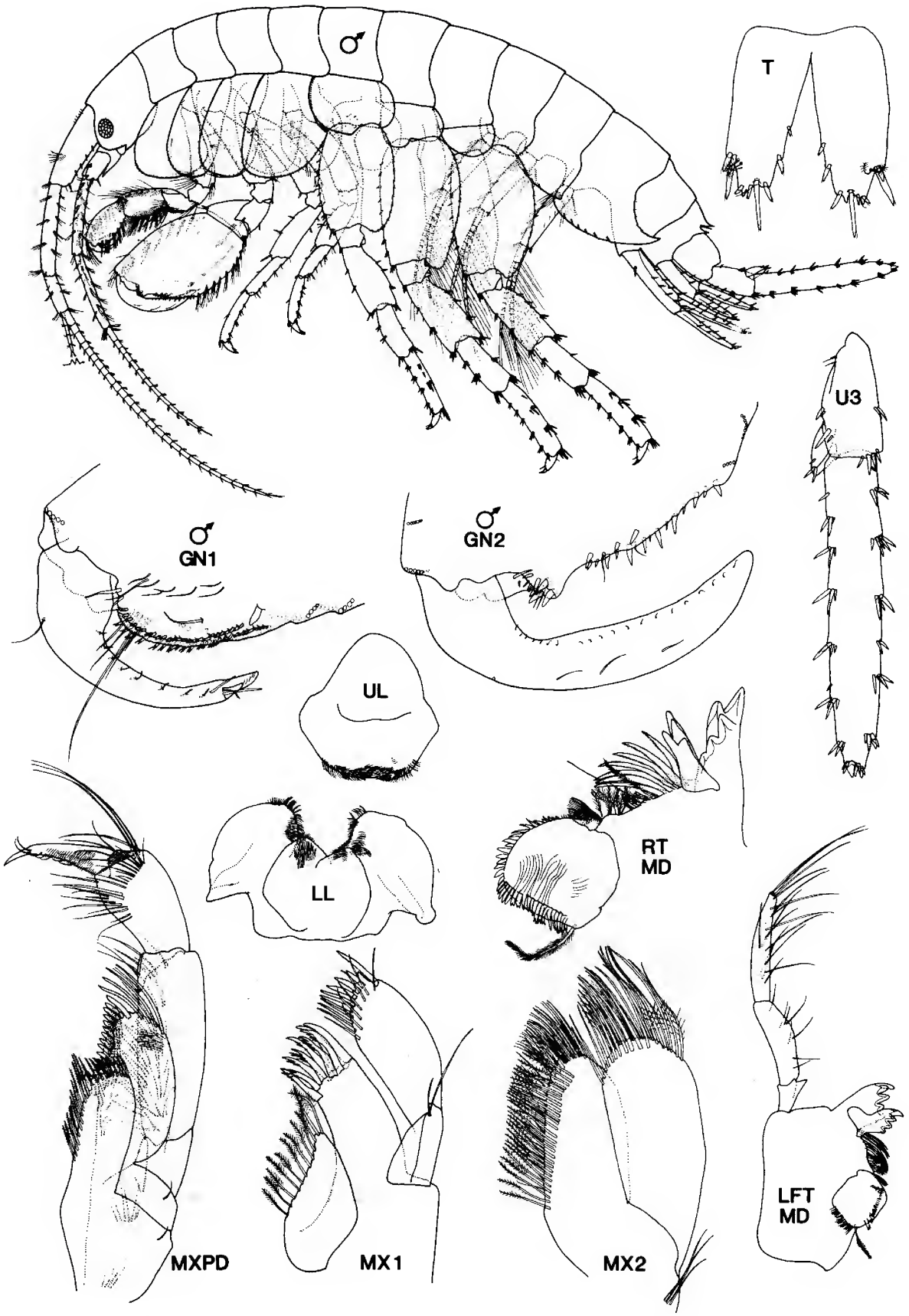

FIG. 29. ***Desdimelita barnardi,*** **new species. Trevor Channel (P5), B. C. Male (8.0 mm).**

Coxa 1 medium distally broad, nearly as wide as deep, gently rounding anteriorly. Coxa 4 narrow, deeper than broad. Gnathopod 1, propod slender, a little shorter than carpus; palm very oblique, strongly convex near hinge, lined with very fine fork-tipped spinules. Gnathopod 2, carpus, hind lobe narrow, deep; propod large, a little longer than deep, palm oblique, unevenly convex, with strong hinge tooth; dactyl heavy, thick, with few outer marginal setae, inner margin lined with minute setules. Peraeopod 3 larger than 4; dactyls medium, length < 1/4 segment 6. Peraeopods 5-7, basis broad, slightly dissimilar, basis of peraeopods 6 & 7 narrowing distally to relatively small hind lobes; dactyls medium,~ 1/4 segment 6. Peraeopod 5, segment 4 slender.

Pleon segment 2, hind corner slightly acuminate; pleon 3, hind corner strongly produced, acute, lower margin with ~6 short spines. Uropod 1, peduncle relatively short; rami with 3-4 marginal spines. Uropod 3, outer ramus relatively long, margins subparallel, each with 6-7 groups of spines; terminal segment very small.

Telson lobes relatively large, each with 2 longish subapical spines, inner margins with 2 short spines.

Coxal gills broadly saclike, rounded below; gill 6 distinctly smaller and narrower.

Female unknown.

Etymology. The species is named in honour of the late J. L. (Jerry) Barnard who contributed very broadly to knowledge of melitid amphipods and described the type species of the genus *Desdimelita.*

Distribution. Known only from type locality

Taxonomic commentary. The species is moderately advanced, but is more closely related to primitive members within the genus.

Desdimelita microphthalma, new species
(Fig. 30)

Material Examined.
ALASKA:
Southeastern Alaska, ELB Stn. S5B1 (Hogan I.), intertidal, slaty gravel, July 28, 1980 - male (6.0 mm) **Holotype**, female ov. (4.5 mm) **Allotype**, 2 male, 2 female, **Paratypes.** CMN collections, Ottawa.

Diagnosis. Male (8.0 mm). Urosome 1 with ordinary single postero-dorsal cusp. Urosome 2, postero-dorsal paired teeth small, each encompassing single short spine. Eye very small, rounded; inferior antennal notch relatively large, open. Antenna 1, peduncle 1 with 2 proximal posterior marginal spines, segment 2 ~ segment 1; flagellum relatively short, with ~16 segments; accessory flagellum 5-segmented. Antenna 2, flagellum short, with ~8 moderately setose segments.

Mandible, spine row with 8-9 slender blades; palp segment 3 weakly setose. Maxilla 1, inner plate with 9 marginal setae; palp segment 1 with 2-3 shoulder setae. Maxilla 2, inner plate lacking distinct distal oblique facial row of setae. Maxilliped, inner plate with 8-9 inner marginal setae; outer plate medium, >2/3 palp segment 2.

Coxa 1 medium, distally broad, deeper than wide, rounding anteriorly. Coxa 4 medium, deeper than broad. Gnathopod 1, propod short, broadening distally; palm regularly oblique, convex near hinge, lined distally with fork-tipped spinules; dactyl distally attenuated. Gnathopod 2, carpus, hind lobe narrow, deep; propod large, a little longer than deep, palm oblique, unevenly convex, with strong hinge tooth; dactyl heavy, thick, with few outer marginal setae, inner margin lined with minute setules. Peraeopod 3 larger than 4; dactyls medium, length < 1/4 segment 6. Peraeopods 5-7, basis broad, slightly dissimilar, that of peraeopods 6 & 7 narrowing distally to relatively small hind lobes; dactyls medium,~ 1/4 segment 6. Peraeopod 5, segment 4 slender.

Pleon segment 2, hind corner slightly acuminate; pleon 3, hind corner strongly produced, acute, lower margin with ~6 short spines. Uropod 1, peduncle relatively short; rami with 3-4 marginal spines. Uropod 3, outer ramus relatively long, margins subparallel, each with 6-7 groups of spines; terminal segment very small.

Telson lobes relatively large, each with 2 longish subapical spines, inner margins with 2 short spines.

Coxal gills broadly saclike, rounded below; gill 6 distinctly smaller and narrower.

Female ov.(9.0 mm). Gnathopod 1, propod slightly narrower, palm more vertical but less strongly lined with spinules, and dactyl less basally swollen, than in male. Gnathopod 2, propod relatively small, little larger than carpus, palm oblique, nearly straight. Coxa 6, anterior lobe shallow, unmodified.

Etymology. From the Greek roots words "mikros" (small) and "ophthalmos" - eye, with reference to the small pigmented eye.

Distributional Ecology. Known only from the type locality, Hogan Island, southeastern Alaska.

Taxonomic commentary. About half the character states of *Desdimelita microphthalma* are apomorphic, making it one of the most advanced species of the genus.

Desdimelita transmelita, new species
(Fig. 31)

Material Examined.
BRITISH COLUMBIA:
Vancouver Island, south end, ELB Stn. B21a (off Brady's Beach), 16-30 m., sand, June 1, 1977 - female ov. (6.0 mm) **Holotype**; Stn. B21b (off Brady's Beach), 10-20 m., sand - 1 male subadult (5.5 mm) **Allotype**. No other specimens. CMN collections, Ottawa.

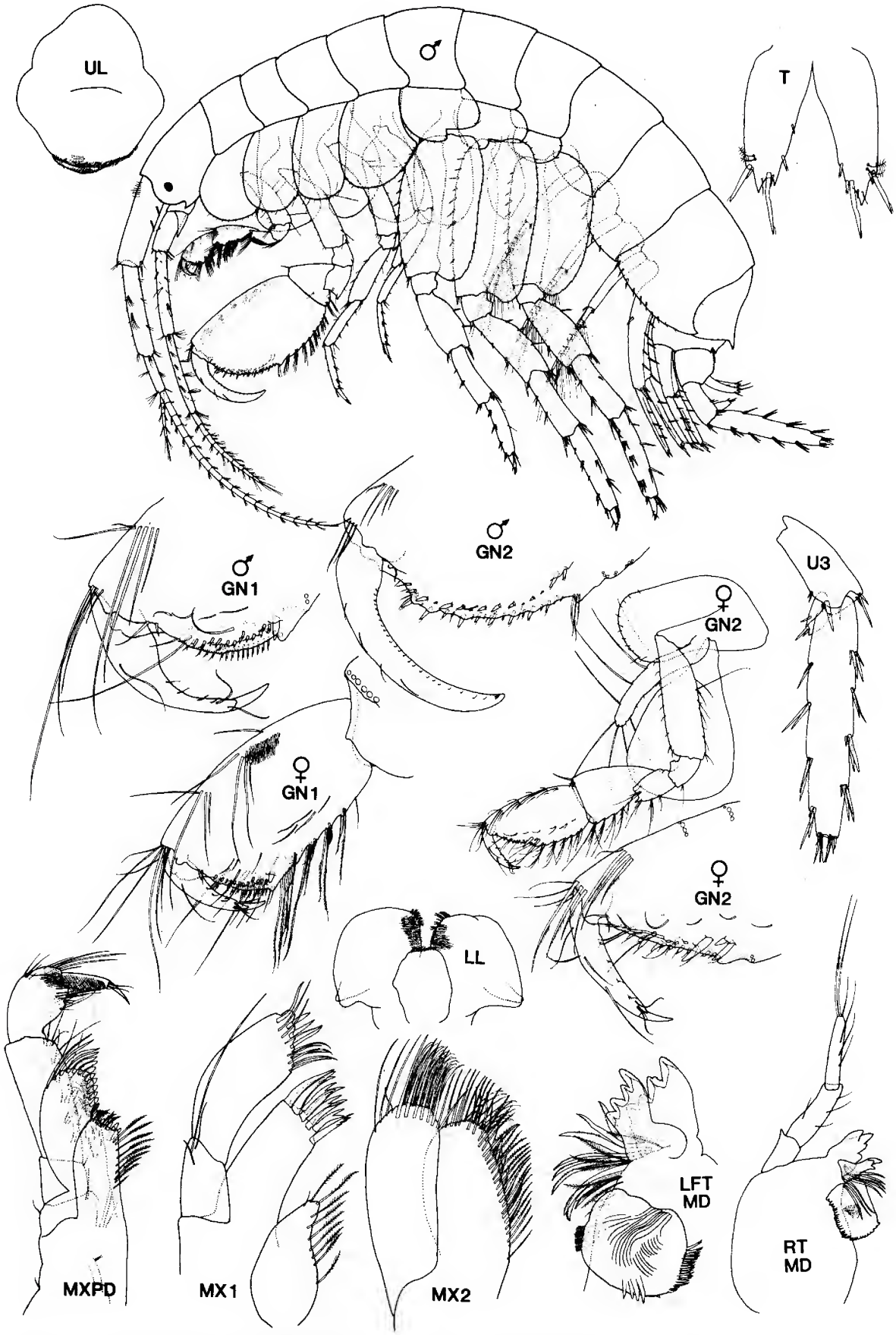

FIG. 30. ***Desdimelita microphthalma*****, new species. Hogan I. (S5B1), southeastern Alaska. Male (6.0 mm); female (4.5 mm).**

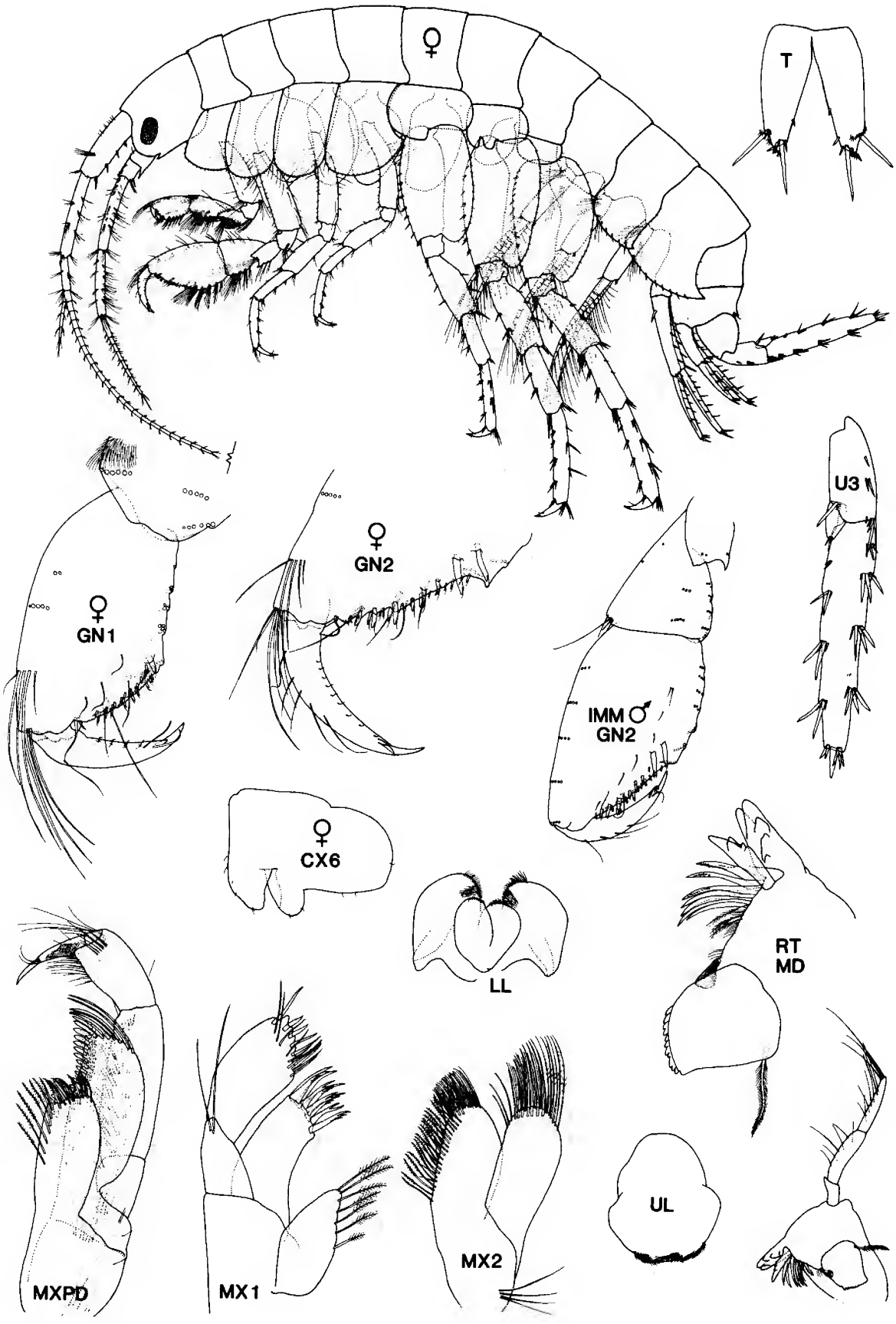

FIG. 31. ***Desdimelita transmelita,*** **new species. Off Brady's Beach, British Columbia. Female (6.0 mm); subadult male (5.5 mm).**

Diagnosis. Female ov. (6.0 mm). Urosome 1 lacking postero-dorsal cusp. Urosome 2, postero-dorsal paired teeth small, each encompassing single spine longer than teeth. Eye somewhat oval, elongate. Inferior antennal notch small. Antenna 1, peduncle 1 with 3-4 proximal posterior marginal spines; segment 2 >segment 1; flagellum medium, with 20+ segments; accessory flagellum 4-segmented. Antenna 2, flagellum short, with ~8 moderately setose segments.

Mandible, spine row with 8-9 slender blades; palp segment 3 moderately setose. Maxilla 1, inner plate with 7 marginal setae; palp segment 1 with 2 lateral setae, segment 2 very broad, apically shallowly dentate. Maxilla 2, inner plate with distal oblique row of 3 setae. Maxilliped, inner plate with 6-7 inner marginal setae; outer plate medium, >3/4 palp segment 2.

Coxa 1 very little expanded distally. Coxa 4 narrow, deeper than broad. Gnathopod 1, carpus a little longer than propod; propod little longer than deep, palm oblique, nearly straight; dactyl with short inner marginal setules. Gnathopod 2, carpus, hind lobe narrow, deep; propod large, longer than deep, palm oblique, nearly straight, very weakly toothed near hinge; dactyl heavy, thick, with 3-4 outer marginal setae, inner margin lined with minute setules; unguis distinct.

Peraeopod 3 larger than 4; dactyls relatively long, <1/3 segment 6. Peraeopods 5-7, basis regularly broad, similar, not narrowing distally, hind lobes regular; dactyls medium,~ 1/4 segment 6. Peraeopod 5 not markedly smaller than 6 & 7; segment 4 slender, not expanded. Coxa 6, anterior lobe bifid, each lobe rounded (not sexually modified) below.

Pleon segment 2, hind corner slightly acuminate; pleon 3, hind corner moderately produced, acute, lower margin with ~8 medium spines. Uropod 1, peduncle relatively short; rami with 4-5 marginal spines. Uropod 3, outer ramus regular, margins each with 4 groups of spines; terminal segment medium, slender.

Telson lobes relatively long, each with 2 longish subapical spines, inner margins with 1-2 short spines.

Coxal gills broadly saclike, rounded below; gill 6 distinctly smaller and narrower.

Subadult male (5.5 mm). Gnathopods 1 & 2 similar to those of adult female.

Etymology. The species name is derived from the Latin "trans" (across) and the generic root *"Melita"*, with reference to its intermediate position between the *Abludomelita* and *Melita* generic complexes.

Distributional ecology. Known only from off Brady's Beach, Trevor Channel, Vancouver Island, B. C.

Taxonomic commentary. *Desdimelita transmelita* appears somewhat transitional to the Asiatic subgroup of *Melita,* mainly because of the bifid anterior lobe of coxa 6. Regrettably, gnathopod 1 of the mature male that would provide further evidence of full generic relationships, is unknown.

Melita Leach

Melita Leach, 1814: 403.—Karaman, 1981: 41.
Caliniphargus Stout, 1913: 640.
non *Megamoera* Bate, 1862: 224.

Type species: *Cancer palmatus* Montagu, 1804 (monotypy)

Species.

1. World. (a) Typical, with dorsal tooth on urosome 1 (*otherwise aberrant): *Melita celericula* Croker, 1971*; *M. dulcicola* Stock & Vonk, 1990*; *M. festiva* Chilton, 1885 (see Hurley, 1954); *M. gayi* Nicolet, 1849 (see also Schellenberg 1931); *M. hergensis* Reid, 1939 (see Ruffo, 1982, fig. 228); *?M. machaera* K.H.Barnard (see Griffiths, 1976); *M. orgasmos* K.H. Barnard, 1940 (see Ledoyer, 1979, fig. 12); *M. planaterga* Kunkel, 1910*; *M. plumulosa* Zeidler, 1989*; *M. reidi* Hamond, 1965; *M. solada* J. L. Barnard, 1961; *M. sulca* (Stout, 1913); *M. tristanensis* K. H. Barnard, 1965.

(b) Atypical, lacking dorsal tooth on urosome 1: *Melita awa* Barnard, 1972)*; *M. alluaudi* Ledoyer, 1982; *M. bulla* G. Karaman, 1978; *M. coronini* Heller, 1866; *M. elongata* Sheridan, 1980; *M. inaequistyla* (Dana, 1852); *M. intermedia* Sheridan, 1980; *M. laevidorsum* Stephensen, 1944b; *M. longisetosa* Sheridan, 1980; *?M. matilda* Barnard, 1972*; *M. mangrovae* Oliveira, 1953*; *M. lagunae* Oliveira, 1953; *M. nitida* Smith, 1873; *M. nitidula* Ruffo, 1958*; *M. oba* Barnard, 1972*; *M. pahuwai* Barnard, 1970; *M. valesi* S. Karaman, 1965*; *M. zeylanica* Stebbing, 1904 (see also Ledoyer, 1979; Griffiths, 1975); *M. zeyalanica kauerti* Barnard, 1972.

(c) Incerta sedis:

M. podager (M.-E., 1830) (no information available).

2. North Pacific species.

North American: *Melita alaskensis*, n. sp. (p. 53); *M. nitida* Smith, 1873 (see also Chapman, 1988); *M. oregonensis* Barnard, 1954; *M. sulca* (Stout, 1913) (see also Barnard, 1969b).

Asiatic: *Melita bingoensis* Yamato, 1987; *M. hoshinoi* Yamato, 1990; *M. koreana* Stephensen, 1944 (see also Yamato, 1987); *M. longidactyla* Hirayama, 1987; *M. nagatai* Yamato, 1987; *M. piloprotopoda* Hirayama, 1987; *M. quadridentata* Yamato, 1990; *M. rylovae* Bulycheva, 1955 (see also Yamato, 1987); *M. setiflagella* Yamato, 1988; *M. shimizui* (Ueno, 1940)(see also Yamato, 1988); *M. tuberculata* Nagata, 1965.

Diagnosis. Head, inferior antennal sinus variously incised, anterior and posterior lobes rounded. Pleon segments usually not (or very weakly) dorsally toothed. Urosome segment 1 with or without dorsal tooth. Urosome 2 with paired dorsal teeth and/or spine groups. Antennae strong; antenna 2, flagellar segments often ringed with "bottlebrush" setae.

Mandible, right lacinia spike-like, multidenticulate; left lacinia 4-dentate. Maxilla 1, outer plate with 9 (occasonally 6-7) apical spines; inner plate subtruncate, distal margin 4-10 setose; palp segment 1 lacking shoulder setae (usually), segment 2 disto-medially broadened, apex (of right palp) dentate. Maxilla 2, inner plate, with distal marginal setae only. Maxilliped plates strong; palp segment 2 sublinear; dactyl stout, curved.

Coxae 1-3 lacking hind marginal cusps; coxa 4 squarish or evenly rounded below. Gnathopod 1 (male), carpus slender, longer than propod, antero-distal lobe usually finely pilose (both sexes); propod slender, dactyl short, highly modified, with basal bulge or swelling. Gnathopod 2, propod postero-distally broadened, unproduced, inner face often strongly setose and distally excavate to accommodate tip of large acute dactyl; palmar margin usually lacking hinge tooth.

Peraeopods 3 & 4 variously unequal in size. Peraeopods 6 & 7 larger than 5, bases lobate; segment 4 variously broadened.

Coxa 6 (female), antero-ventral lobe modified, deep, often hook-like, pre-copulatory in function.

Pleon plate 3, hind corner squarish, acuminate or moderately produced. Uropod 3, inner ramus small, outer ramus strong, terminal segment usually lacking. Telson lobes separated to base, apices and inner margins spinose.

Coxal gill 6 various, often small.

Behavioural characteristics. The uniquely modified form of the propod palmar region and dactyl of gnathopod 1 (male), and modified anterior lobe of coxa 6 (female), have long been known taxonomically (e.g., Sars, 1895; Stebbing, 1906). Only relatively recently, however, has their pre-amplexing (mate-carrying) functional interrelationship been demonstrated and their phyletic relationship more fully appreciated (e.g., Borowsky, 1984; Conlan, 1991; Bousfield & Shih, 1994). This conspicuous morphological and behavioural feature is apparently characteristic of members of the genus *Melita* sens. str. and close allies, but is only partially, or not at all, developed in the *Abludomelita* complex of genera.

Taxonomic and biogeographical commentary. Karaman (loc. cit.) was fully justified in separating *Melita* and *Abludomelita* on both taxonomic and distributional bases. Regrettably, however, he did not correctly categorize some of the species included in this North Pacific study; thus the world-wide fauna should similarly be re-examined.

Members of the genus *Melita* are strikingly different from *Abludomelita* and related generic complexes in characters above. *Melita* and related genera are Gondwana relict groups whose members are tropical and warm temperate, with relatively limited penetration into the North Atlantic and North Pacific regions.

Yamato (1990) agrees with Zeidler (1989) that the presence or absence of a terminal segment of uropod 3 is of no generic significance. As Yamato (loc. cit.) further intimated, we are here formally diagnosing genera on the basis of numerous character states, in which presence or absence of a terminal segment of uropod 3 may be, in combination with other states, a generically definitive taxonomic feature.

Melita oregonensis J. L. Barnard
(Figs. 32, 33)

Melita oregonensis Barnard, 1954: 19, pls. 18-20.—Karaman, 1981: 41.—Austin, 1985: 610.—Staude, 1987: 384.—Barnard & Barnard, 1983: 665 .

Material Examined.

ALASKA:

Southeastern Alaska, ELB Stns., 1961: A147 (southwest of Pt. Gilmour, Montagu I.), intertidal, rock, boulders, July 14 - male (9.0 mm) (**figured**), female ov. (7.0 mm) (**figured**); also A3, A6, A46, A54, A151, A168 - 55 specimens. ELB Stns., July-Aug., 1980: 7 localities (incl. S5B1) - 40 spmns.

BRITISH COLUMBIA:

Queen Charlotte Islands, ELB Stns., July-August, 1957: W2, W4b, H3, H7, H14, E25 - 66 specimens. G. C. Carl Stn., Anthony I., Oct. 17, 1956 - 2 specimens.

North-central mainland, ELB Stns., July-August, 1964: H1, H12, H53, H59, H65 - 18 specimens.

Vancouver Island, north end, ELB Stns., 1959: O4b, O11, O15 - 18 specimens. Vancouver Island, south end, ELB Stns., July, 1970: P710, P714, intertidal - 16 specimens. ELB Stns., July-Aug-ust, 1975: P3a, P17d, P18a, P20a, P21a, P29a, intertidal to 14 m., sand, gravel - 18 specimens. ELB Stns., July, 1976: B3, B7, B28, intertidal - 60 specimens. ELB Stn. B6a, May, 1977- 1 specimen.

WASHINGTON:

ELB Stns., 1966: W35 (Agate Beach), intertidal, sand, gravel, July 28 - 15 specimens; W40 (Mukkaw Bay at Sooes Pt.), fine sand, shelly sand, July 31 - 6 specimens.

Diagnosis. Male (9-12 mm). Anterior head lobe rounded, with squarish inferior incision, lower lobe rounded. Urosome 1 smooth dorsally; urosome 2 with 2 dorso-lateral teeth on each side, on each side of a single short slender spine. Antennae large, peduncles stout, setose. Antenna 1, proximal posterior margin of peduncular segment 1 with 3-4 short spines; segment 3 long (~1/2 segment 2); flagellum with 20-30 segments; accessory flagellum 3-4 segmented. Antenna 2, flagellum 12-14 segmented, each with whorl of short setae

Lower lip, inner lobes medium, distinct. Mandible, spine row with 6-8 blades; palp segments 2 & 3 moderately setose. Maxilla 1, inner plate with 8-10 plumose setae; palp segment 2 medially broadened, right palp apically with setae, short spines and 2-3 teeth; segment 1 marginally bare. Maxilla 2, inner margin of inner plate lined with 8-9 setae. Maxilliped, inner plate with 12-14 inner marginal setae, apex truncate; outer plate, inner margin with numerous (20-25) chisel teeth lengthening distally to strong, curved slender spines; palp strong, segment 2 columnar.

KEY TO EASTERN NORTH PACIFIC SPECIES OF *MELITA* SENS. STR.

1. Urosome 1 with dorsal tooth; uropod 2, rami subequal; telson lobes each distally with 3-4 long spines, gnathopod 1 (male), dactyl minute, masked distally by propod . . . . . *M. sulca* (Stout) (p. 59)
—Urosome 1 smooth above; uropod 2, outer ramus distinctly the shorter; telson lobes each distally with short spines or 1-2 long spines; gnathopod 1, dactyl fully visible beyond propod . . . . . 2.

2. Urosome 2, posterodorsal margin with short spines only; coxa 4 very broad, lower margin straight; peraeopods 6 & 7, bases narrowing distally to small hind lobes; telson with short apical spines; antenna 2 (male), flagellum with strong "bottle brush" setae. . . . . *M. nitida* Smith (p. 57)
—Urosome 2, posterodorsal margin with pairs of small teeth surrounding single spines or not; coxa medium broad, lower margin rounded; peraeopods 6 & 7, bases not narrowing distally, hind lobes normal; telson lobes each with 1-2 long apical spines; antenna 2 (male) flagellar segments normally setose . 3.

3. Pleon plate 3, hind corner acutely produced, weakly serrate below; telson apices with 2 long spines; peraeopod 5, segment 4 broadened, width > 1/2 length . . . . . *M. oregonensis* J. L.Barnard (p. 52)
—Pleon plate 3, hind corner squarish, acuminate; telson apices with single long spine; peraeopod 5, segment 4 little broadened, width < 1/2 length . . . . . *M. alaskensis* n. sp. (p. 53)

Coxae 1-4 medium, uniformly deep, rounded below. Coxa 1 broadened distally. Gnathopod 1, basis antero-distally setose; carpus slender, sublinear; propod shorter, anterior margin convex, distally overhanging base of short, basally bulging dactyl that closes on short, oblique, finely spinose palm. Gnathopod 2, basis with few antero-distal setae; carpus short, deep, length of posterior lobe about half anterior margin; medial face of propod with large richly setose distal depression; palm regularly convex, oblique, setose and spinulose; dactyl relatively short.

Peraeopod 3 distinctly larger than 4, dactyls short. Peraeopods 6 & 7 larger than 5; coxae distinctly anterolobate; bases broad, smoothly convex behind, lower lobes shallow but distinct. Peraeopod 5, segment 4 stout, moderately broadened. Peraeopods 6 & 7, segment 4 longer than 5; segment 6, margins spinose; dactyls short.

Pleon plate 3, hind corner moderately produced, acute, lower margin weakly serrate distally. Uropod 1, distal peduncular spine medium strong, outer ramus slightly shorter. Uropod 2, outer ramus short, margins strongly spinose. Uropod 3, inner ramus very small; outer ramus strong, about twice length of, and broader than, peduncle, margins with 5-6 clusters of medium slender spines, apex with short spines.

Telson lobes medium, narrowing distally, inner margins with 3-4 short spines, apices subacute, each with 2 strong spines, lateral notches evanescent.

Coxal gills on peraeopods 2-5 medium large, saclike; gill on peraeopod 6 distinctly smaller, less broad.

Female ov.(7-8 mm). Gnathopod 1, carpus relatively deep, lower margin convex; propod with regular, convex, nearly vertical palm; dactyl regular. Gnathopod 2 relatively small, carpus and propod shallow, subequal in length; palm oblique, nearly straight.

Coxa 6, anterior lobe forming a strong, sharply hooked process; stridulating ridges not observed.

Distributional ecology. From southeastern Alaska and British Columbia, south to Oregon and northern California, under rocks at LW level. mainly at outer coast localities, in summer temperatures of 12-17°C. and salinities of 30+‰.

Taxonomic commentary. *Melita oregonensis* is closely similar to *M. alaskensis* (below) but differs mainly in the form of gnathopod 1, and the larger gnathopod 2. Barnard (1954) noted its relatively close similarity to *M. nitida* Smith. It is quite unlike the dorsally dentate *M. sulca,* with which it overlaps distributionally in southern parts of its range, and the type species, *M. palmata* of western European waters. However, *M. oregonensis,* and *M. alaskensis,* cluster more closely with the Japanese complex of species (Fig. 41, p. 68).

Melita alaskensis, new species
(Fig. 34)

Material Examined.
ALASKA:
Southeastern Alaska, ELB Stns., 1961: A164 (Imperial Passage, northwest side of Hogan I.), under boulders at LW level, temperature 12.5° C., salinity 22.5‰, July 23 - male 7.5 mm) **Holotype**, female ov. (7.0 mm) **Allotype**, 3 male, 60 female, 7 juvenile **Paratypes**; A7 (Bostwick Bay), June 2 - 4 males, 1 female; A22 (near Sitka), June 2 - 1 female, 1 juvenile; A129 (Anchor Cove), July 10 - 3 males, 3 females; A151 (east of Johnstone Inlet), July 15 - 5 males, 5 females. CMN collections, Ottawa.

Diagnosis. Male (7.5 mm). Anterior head lobe rounded, with acute inferior incision, lower lobe rounded. Urosome 1 smooth dorsally; urosome 2 nearly smooth dorsally. Antennae large, peduncles stout, moderately short setose. Antenna 1, posterior margin of peduncular segment 1 with 4-5 medium spines; segment 3 long (~1/2 segment 2); flagellum with 20-25 segments; accessory flagellum with 3 1/2 segments. Antenna 2, flagellum with about 10 segments, each with whorl of short setae.

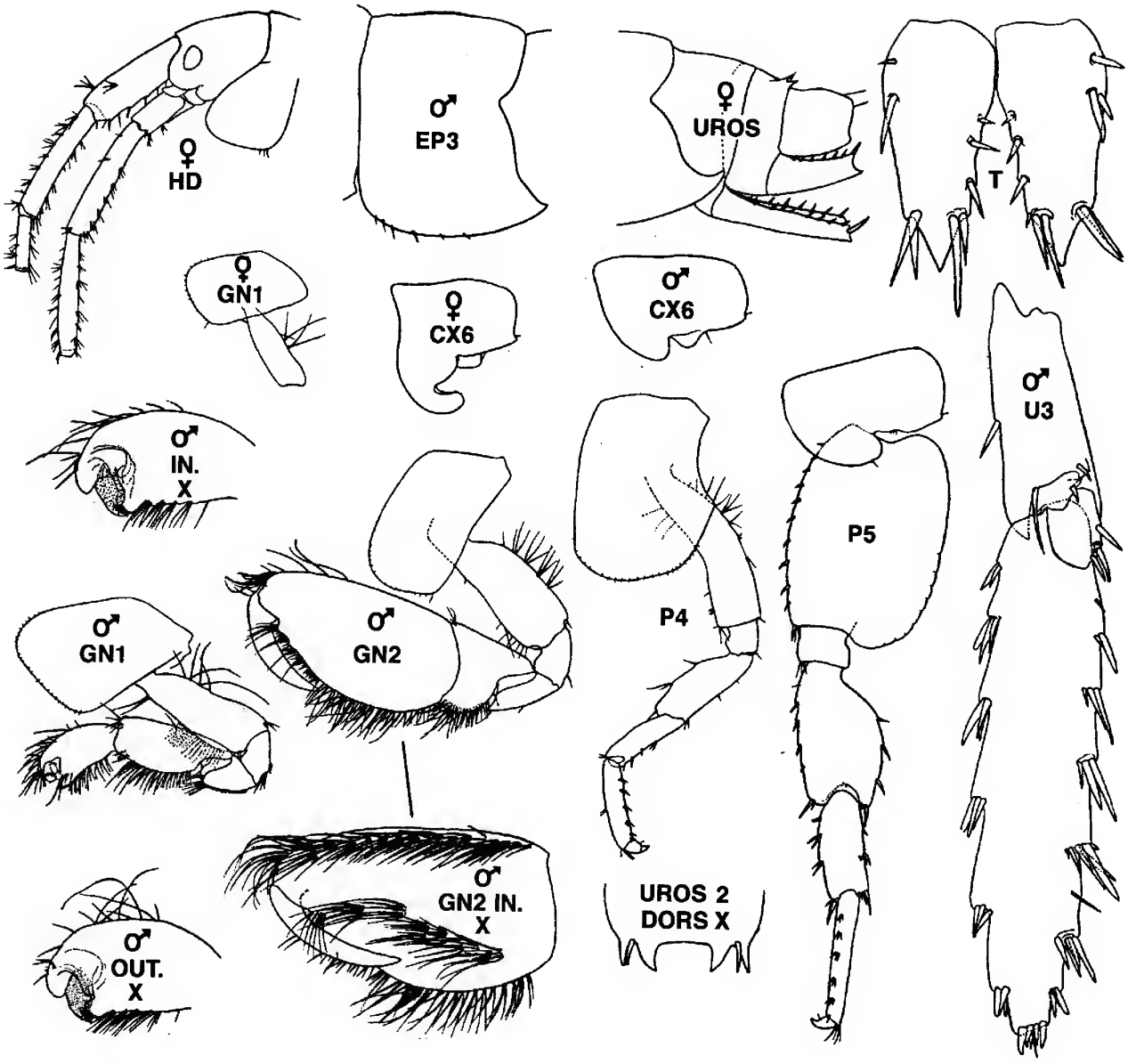

FIG. 32. *Melita oregonensis* Barnard, 1954. Coos Bay, Oregon. Male (12.0 mm); female (14.0 mm).

Lower lip, inner lobes medium, distinct. Mandible, spine row with 6-7 blades; palp segments 2 & 3 moderately setose. Maxilla 1, inner plate with 6-7 plumose setae; outer plate with 9 apical spines; palp segment 2 distally broadened, right palp apically with setae, slender spines and 4 teeth; segment 1 marginally bare. Maxilla 2, inner margin of inner plate lined with 8-9 setae, longest distally. Maxilliped, inner plate with 7-8 inner marginal setae, apex truncate; outer plate, inner margin with about 15 chisel teeth lengthening distally to about 6 strong, curved slender spines; palp strong, segment 2 columnar.

Coxae 1-4 medium large, uniformly deep, broadly rounded below. Coxa 1 broadened distally. Gnathopod 1, basis distal half of anterior margin strongly setose; carpus slender, sublinear; propod relatively short and deep, anterior margin markedly convex, distally strongly overhanging base of short, basally swollen dactyl, the unguis of which closes on a very short, oblique, finely spinose palm. Gnathopod 2 medium, basis nearly lacking anterodistal setae; carpus short, relatively shallow, length of posterior lobe more than half anterior margin; medial face of propod with long moderately setose distal groove; palm regularly convex, very oblique, richly spinulose; dactyl medium, inner margin lined with fine setules.

Peraeopod 3 slightly larger than 4; dactyls short. Peraeopods 6 &7 larger than 5; coxae distinctly anterolobate; bases broad, smoothly convex behind, lower lobes shallow but distinct. Peraeopod 5, segment 4 stout, moderately broadened. Peraeopods 6 & 7, segment 4 slightly longer and broader than 5; segment 6, margins spinose; dactyls very short.

Pleon plate 3, hind corner subtruncate, weakly acuminate,

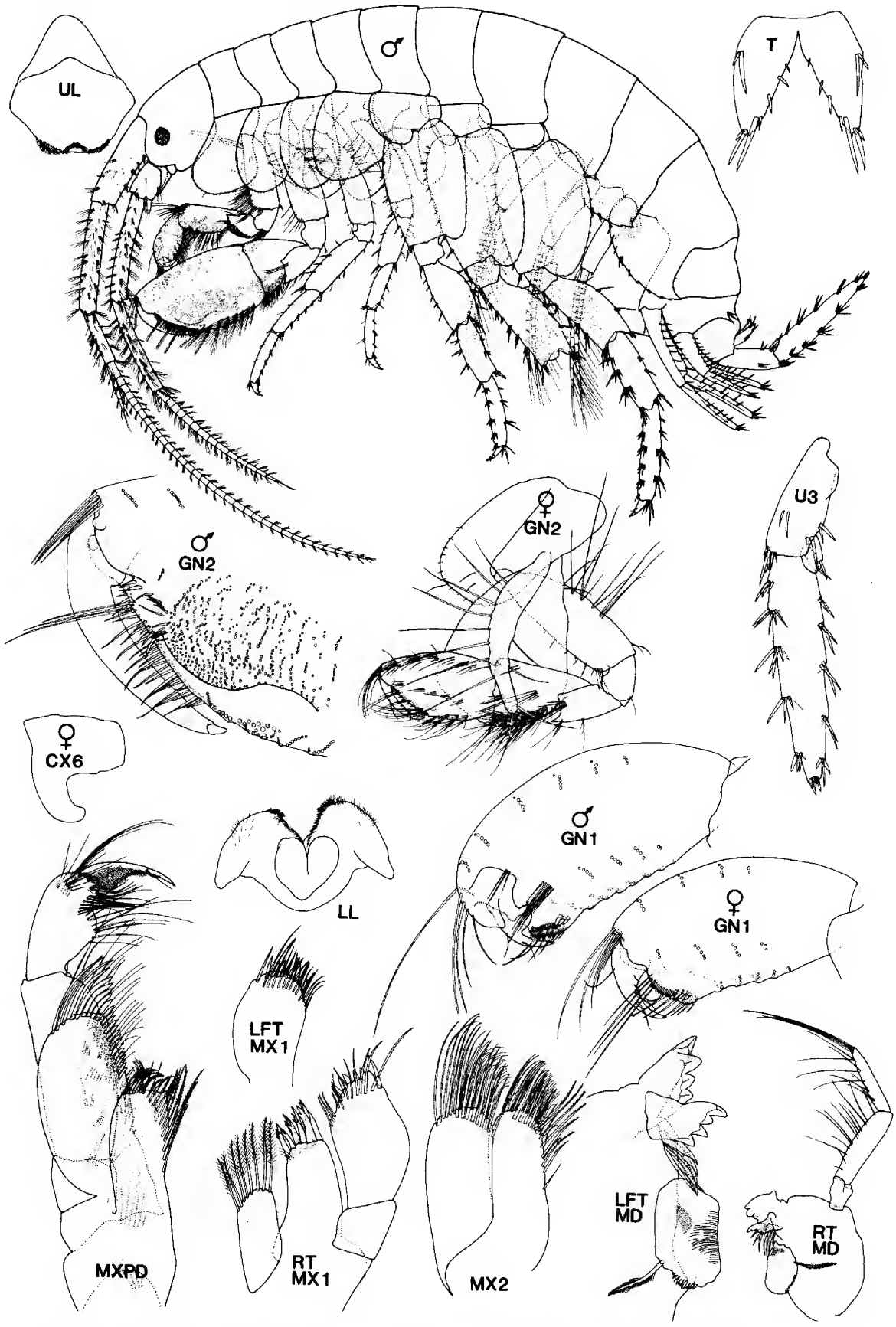

FIG. 33. ***Melita oregonensis*** **J. L. Barnard, 1954. Pt. Gilmour (A147), southeastern Alaska. Male (9.0 mm); female (7.0 mm).**

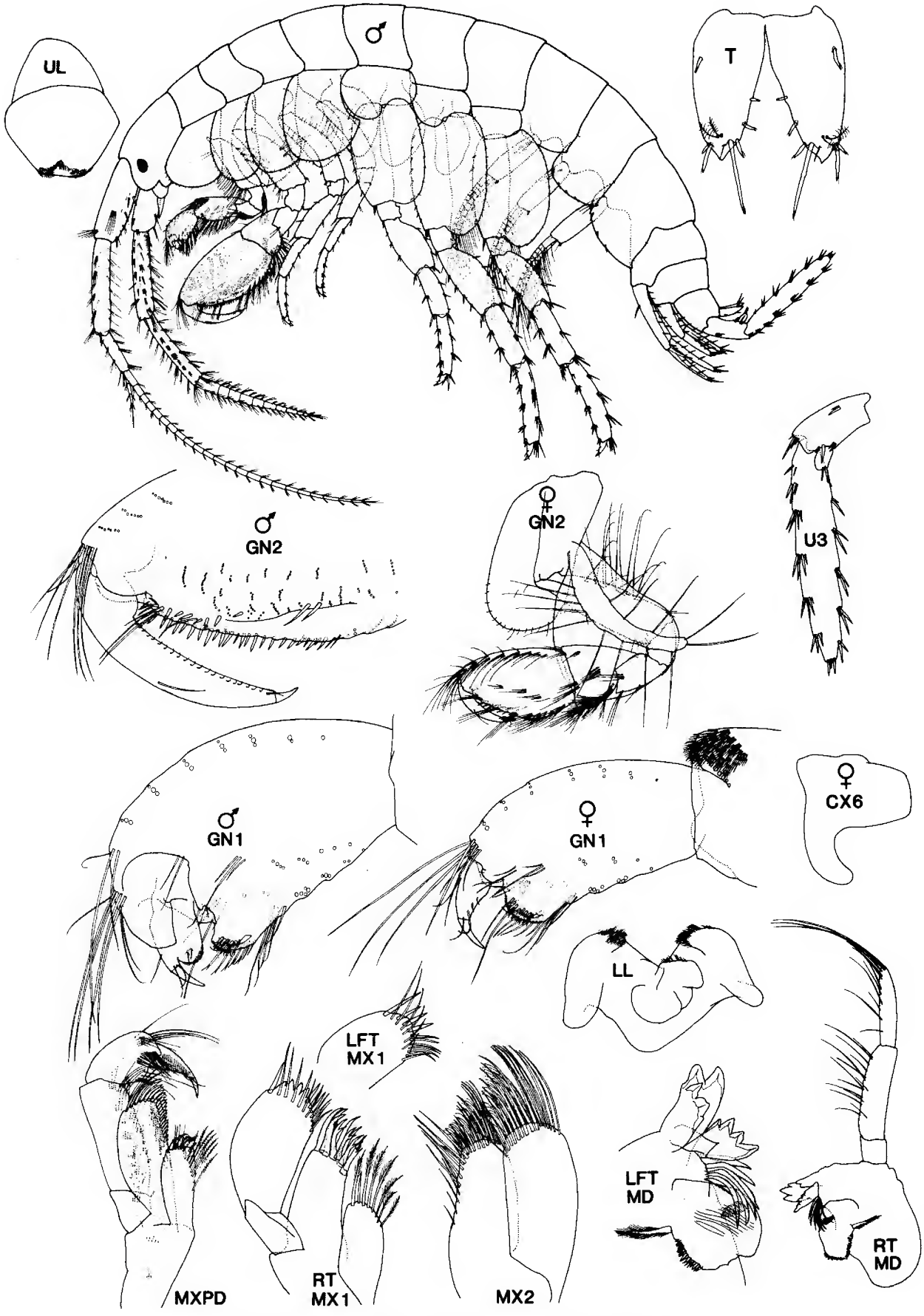

FIG. 34. ***Melita alaskensis,*** **new species. Hogan I. (A164), souheastern Alaska. Male (7.5 mm); female (7.0 mm).**

lower margin not noticeably serrate. Uropod 1, distal peduncular spine long, slender; tips of rami exceeding uropod 2, outer ramus slightly the shorter. Uropod 2, outer ramus the shorter, margins strongly spinose. Uropod 3, inner ramus very small; outer ramus strong, more than twice length of, but little broader than peduncle, margins with 5-6 clusters of medium spines, apex with short spines, lacking terminal segment.

Telson lobes medium, relatively broad, narrowing apically, inner margins with 2 short spines, apices subacute, each with 2-3 short, and one long, spines, lateral notches evanescent.

Coxal gills on peraeopods 2-5 medium large, saclike; gill on peraeopod 6 not grossly smaller or less broad than gill on peraeopod 5.

Female ov. (7.0 mm). Gnathopod 1, propod relatively slend-er, anterior margin convex, palm nearly vertical, strongly convex; dactyl regular. Gnathopod 2, carpus stout, shorter than, but as deep as propod; propod medium, with regular, oblique, nearly straight palm; dactyl regular.

Coxa 6, anterior lobe forming a deep, gently curved nearly hook-like process; stridulating ridges not observed.

Etymology. The species name alludes to its type locality in southeastern Alaska.

Distributional ecology. Known only from the type locality on Hogan I., southeastern Alaska, under boulders at LW level.

Taxonomic commentary. *Melita alaskensis* is very similar to *M. oregonensis* Barnard but differs in the characters of the key (p. 53) and the character states noted above.

Melita nitida (Smith)
(Figs. 35, 36)

Melita nitida Smith 1874.— Bousfield, 1973: 65, Pl. IX(2). —Levings & McDaniel, 1976: 5?—Austin, 1985: 610 (part).—Chapman, 1988: 372, fig. 5F.
Melita setiflagella Yamato, 1990: 80, figs. 2-6?
non *Melita nitida* Shoemaker, 1935: 70, fig. 2.

Material Examined.
BRITISH COLUMBIA:
South-central mainland, ELB Stns., 1959: N23 (head of Pendrell Sound), intertidal, July 16, 1959 - 1 male, 1 female ov., 2 juveniles.
Vancouver Island, ELB Stns., 1955: G5 (head, Comox Bay), intertidal, brackish - 2 males, 6 females ov.; G22 (Chemainus estuary), intertidal, brackish - 6 males, 3 females ov.
Vancouver Island, outer coast, ELB Stn. O6 (Louis Bay, Nootka I.), intertidal, July, 1959 - 1 specimen.

WASHINGTON:
ELB Stn.W11 (head of Oyster Bay), intertidal, brackish, muddy gravel, July 17, 1966 - 4 males, 1 female, 4 juveniles

OREGON:
ELB Stn. W65 (Tillamook Bay), intertidal, coarse sand, mud, Aug., 1966 - 22 male, female, and juvenile specimens.

Diagnosis. Male (5.5 mm). Anterior head lobe broadly rounded, inferior sinus squarely incised. Urosome 1 dorsally smooth. Urosome 2 with clusters of 3-5 short spines on either side of postero-dorsal margin. Antennae large, peduncles heavy. Antenna 1, hind margin of peduncle 1 with 3-4 short spines proximally; peduncle 3 medium; accessory flagellum very short, 2-segmented. Antenna 2, flagellum with 18-20 segments, armed strongly with "bottle brush" setae.

Lower lip, inner lobes small, indistinct. Mandible, palp segments slender, weakly setose; spine row with 4-5 blades. Maxilla 1, inner plate with 5-6 distal setae, right palp strongly broadened, apex 5-6 dentate. Maxilla 2, inner plate with 9-10 inner marginal setae. Maxilliped, inner plate with 8 inner marginal setae.

Coxae 1-4 medium deep, rounded below, increasing posteriorly. Gnathopod 1, basis, antero-distal margin densely setose; carpus slender, margins subparallel; propod more slender and shorter than carpus, little broadening distally, lower palmar margin strongly oblique. Gnathopod 2, basis less densely setose anterodistally; carpus, hind lobe narrow; propod, medial face with strong superior and inferior submarginal setal groups, and median toothed ridge.

Peraeopods 3 & 4, dactyls medium. Peraeopods 5-7, bases medium broad; bases of 6 & 7 narrowing distally to small hind lobes; segment 4 little broadened; distal segments spinose (not setose); segment 6 distinctly longer and more slender than 5; dactyls medium.

Pleon plate 3, hind corner squarish, slightly acuminate. Uropod 1, distal peduncular spine relatively short, weak; rami medium, subequal. Uropod 2, outer ramus distinctly the shorter. Uropod 3, outer ramus medium, 2.5 X peduncle, margins with 5-6 clusters of medium spines; apex subtruncate, with minute terminal segment and 4-5 short spines.

Telson lobes medium, separated to base, apical spines short, inner margins with short spines. Coxal gills medium, broadly saclike; gill 6 little smaller than gill 5.

Female ov. (4.0 mm). Gnathopod 1, carpus deeper than propod, lower margin convex; propod, palmar margin conmvex, nearly vertical; dactyl regular. Gnathopod 2, carpus relatively short and deep; propod relatively small, little longer than carpus, palmar margin regularly convex, lined with 8-10 short spines.

Coxa 6, anterior lobe modified to shallow, weakly hooked process, with lower submarginal row of 12-15 stridulating ridges or pits.

Distribution. In summer-warm brackish localities of southern B. C. and northern Washington; also in the Columbia estuary, parts of San Francisco Bay, and south of Pt. Conception.

Taxonomic commentary. Chapman (1988) summarized Pacific coast records of this synanthropic species

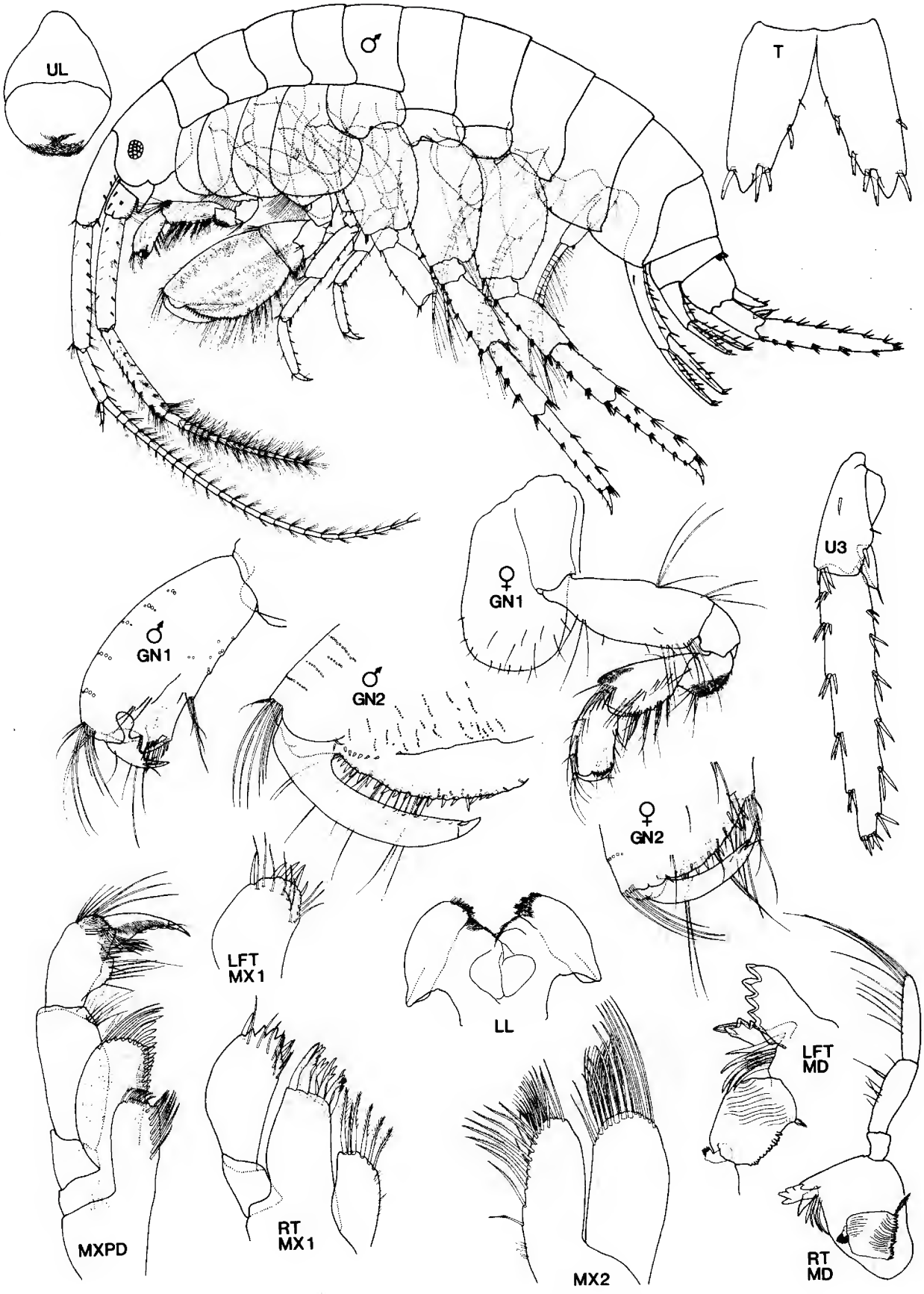

Fig. 35. ***Melita nitida*** **Smith, 1874. Oyster Bay (W11), Washington. Male (5.5 mm); female (4.0 mm).**

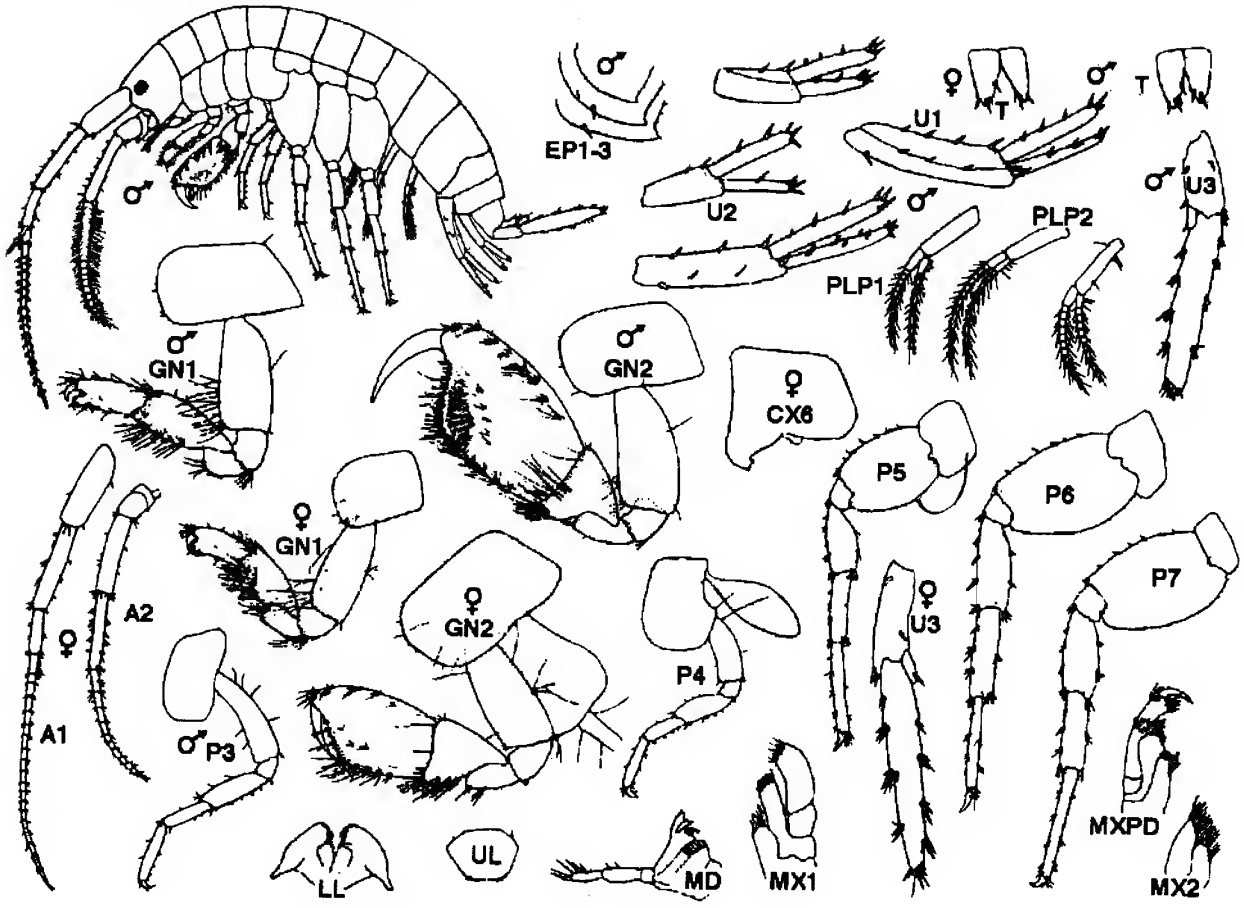

Fig. 36. *Melita nitida* Smith, 1974. Appalachicola estuary, Florida. Male (6.0 mm); female (4.0 mm). (after Sheridan, 1980)

from Howe Sound, Strait of Georgia, B. C., Yaquinna Bay, Oregon, and San Francisco Harbor, CA. He first detailed the structure of the anterior lobe and stridulating ridges of coxa 6 (female).

Dr. S. Yamato (pers. communic.) noted a close similarity between coxa 6 (female) of his material of *M. setiflagella* from Japan, and Chapman's (1988) material of *M. nitida* Smith from the North American Pacific coast. The eastern and western North Pacific populations are, indeed, very similar, in most character states, but should be compared closely with material from the type locality of *M. nitida* on the North American Atlantic coast, previously illustrated by one of us (Bousfield, loc. cit.).

Melita sulca (Stout)
(Fig. 37)

Caliniphargus sulcus Stout, 1913: 641.
Melita palmata (Montagu)? Wailes, 1931: 41.—Shoemaker, 1941b: 187.—Hewatt, 1946: 199.—Ricketts & Calvin, 1968 (4th edition): 39, fig. 23.—Austin, 1985: 609.
Melita sulca (Stout) J. L. Barnard, 1969b: 126, fig. 22.—Barnard, 1975: 361, figs. 42, 81, 154.—Austin, 1985: 610.—Staude, 1987: 373, 384.—Barnard & Barnard, 1983: 666.

Material Examined. The species was not found in present material, even though previously recorded from the study region (Barnard, Austin, Staude, loc. cit.).

Diagnosis. [partly after Stout (1912) and Barnard (1969b)]. Male (Stout: 5-8 mm) (Barnard: to 12.0 mm). Anterior head lobe broadly rounded; inferior antennal notch small, lower apex rounded. Urosome segment 1 with mediodorsal tooth. Urosome 2 with paired dorsal spines, each enclosed basally by pair of unequal teeth. Antennae relatively long. Antenna 1, peduncular segment 1, posterior margin with 4-5 short spines; segment 3 short, accessory flagellum with 2 1/2 segments. Antenna 2, flagellum longer than peduncle, margins with moderately strong "bottle-brush" setae.

Upper lip rounded below. Lower lip, inner plates small, indistinct. Mandible: spine row with 5 blades. Maxilla 1, inner plate with 8 apical plumose setae; outer plate with 7 apical spines; palp segment 2 expanded, apex with blunt spines and a few setae. Maxilla 2, inner plate with inner marginal apical setae, lacking facial row of setae. Maxilliped, outer plate large, inner margin with blunt spines.

Coxae 1-4 medium deep, 4th largest. Coxa 1 little broadened distally. Gnathopod 1, antero-distal margin of basis strongly setose; carpus slender, much longer than

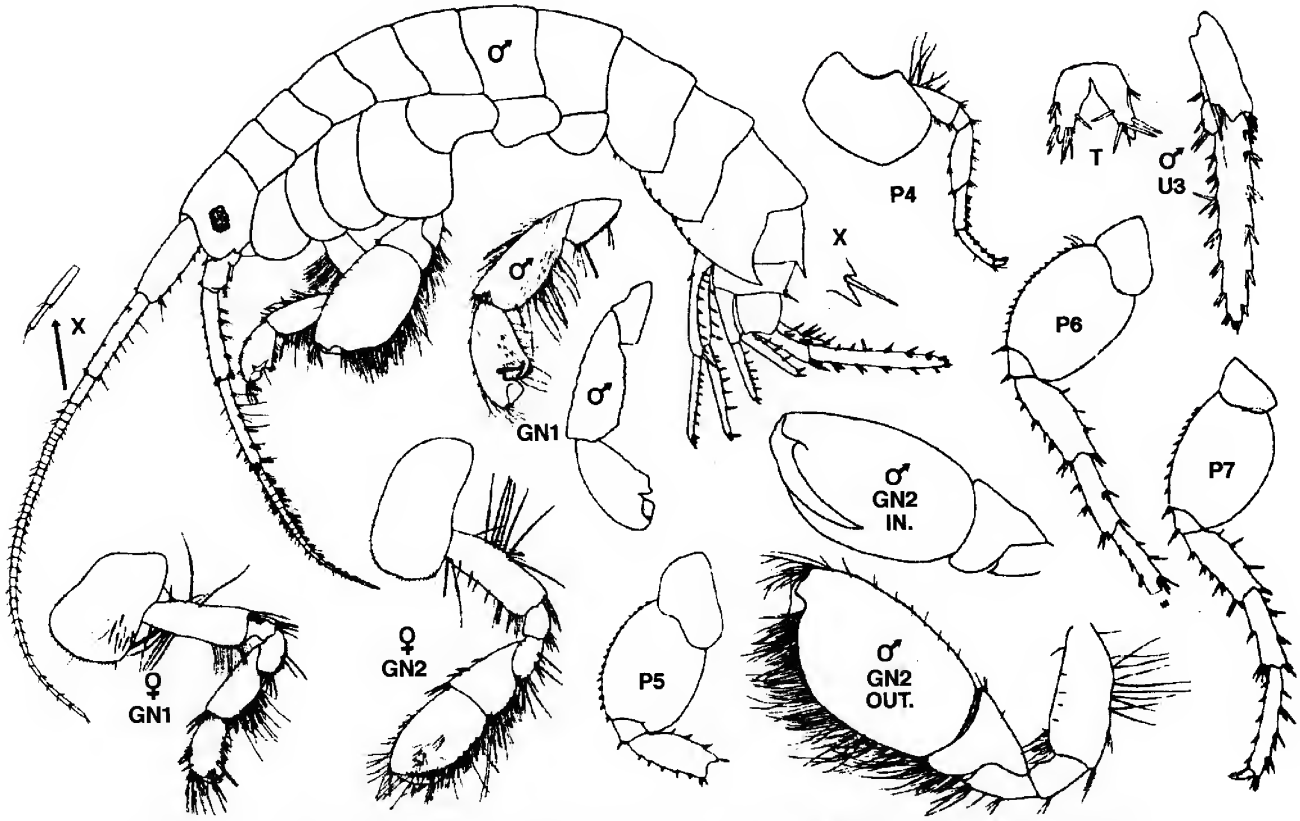

FIG. 37. *Melita sulca* (Stout). Southern California. Male (8-12 mm); female (5-9 mm). (after Barnard, 1969b)

propod; propod broadening distally, strongly overhanging very small dactyl having basal swelling. Gnathopod 2, carpus, hind lobe medium broad, rounded and setose below; propod large, deep, medial face and lower margin strongly setose; acute tip of smooth dactyl closing in deep median palmar depression.

Peraeopod 3 slightly larger than 4; dactyls short. Peraeopods 5-7, coxae shallowly anterolobate; bases broad, hind lobes medium; segment 4 little broadened; distal segments normally spinose (not setose); dactyls short.

Pleon plate 3 , hind corner produced, acute. Uropod 1, peduncle with medium distal spine; rami medium, margins strongly spinose. Uropod 2, rami subequal, margins spinose. Uropod 3, inner ramus small; outer ramus elongate, lacking terminal segment; margins with 5-6 clusters of spines.

Telson lobes short, separated to base, each apex with 2 small spines [strongly spinose, with spines on inner margins (fide Barnard, 1969b)].

Coxal gills and brood plates not described.

Female ov.(5.0 mm). Gnathopod 1, carpus longer and wider than propod, upper and lower margins subparallel; merus with stiff brush-like setules posteriorly; propod broadening distally, with convex setose palm; dactyl regular, larger and stronger than in male. Gnathopod 2 smaller than in male, carpus as deep as, but shorter than, propod; palmar margin more oblique. Coxa 6 not described, but probably possessing a strongly modified antero-ventral lobe.

Taxonomic and distributional commentary: Stout's original material was not re-examined by J. L. Barnard (loc. cit.); his redescription was based on fresh material from La Jolla, California.

This species has been recorded from Washington State and British Columbia by Barnard (1969b), Austin (1985) and Staude (1987). It has also been recorded sparsely from Central California (Carmel, Cayucas, Hazard Canyon, Morro Beach) but appears more common, under rocks at LW to depths of 100+ m., south of Pt. Conception to Baja California. The disparity in descriptive features, sizes, and habitats of material treated by Stout and Barnard (loc. cit.) suggests that more than one species may be involved, and that careful re-examination of all previous materials is therefore recommended.

Western Pacific species of *Melita*.

A rich assemblage of melitoid amphipod species from the Asiatic North Pacific coastal region has been assigned to the genus *Melita,* especially by Nagata (1965), Yamato (1887, 1888, 1890), Hirayama (1987), and Ishimaru (1994): *Melita shimizui* (Ueno, 1940) (see Yamato, 1988: 86, figs. 7-12); *M. koreana* Stephensen, 1944: 39, figs. 6-8 (see also Yamato, 1987, figs 7-9.); *M. rylovae* Bulycheva, 1955 (see also Yamato, 1987: 278, figs. 1-6); *M. nagatai* Yamato, 1987: 289, figs. 11-14; *M. bingoensis* Yamato, 1987: 294, figs.16-20; *M. setiflagella* Yamato, 1988: 80, figs. 2-6; *M. piloprotopoda* Hirayama, 1987: 11, figs. 227-231; *M. quadridentata* Yamato, 1990: 157, figs. 6-10; *M. hoshinoi* Yamato, 1990: 150, figs. 1-5; *M. laevidorsum* Stephensen, 1944: 44; and the aberrant *M. longidactyla* Hirayama, 1987: 2, figs. 221-224, and *M. tuberculata* Nagata, 1965: 295, figs. 28-29.

KEY TO WESTERN NORTH PACIFIC SPECIES OF *MELITA* SENS. STR.*

(*excluding *M. longidactyla* Hirayama and *M. tuberculata* Nagata)

1. Uropod 3, outer ramus with terminal segment; pleon plate 3 hind corner distinctly produced, acute . . 2.
—Uropod 3, outer ramus lacking terminal segment; pleon plate 3, hind corner squarish or finely acuminate (except. *M. piloprotopoda*) . . . . . 4.

2. Uropod 3, margins of outer ramus with clusters of long spines and setae; peraeopods 6 &7, segments 4-6 with marginal setae & spines . . . . . *M. quadridentata* Yamato.
—Uropod 3, outer ramus with ordinary spines only; peraeopods 6 & 7, distal segments with marginal spines only . . . . . 3.

3. Peraeopods 5-7, bases very wide, broadening distally; head lobe broadly rounded, lacking inferior notch; maxilla 1, palp segment 1 with "shoulder" setae. . . . . *M. piloprotopoda* Hirayama.
—Peraeopods 5-7, bases regularly broad or narrowing distally; head anterior margin with inferior antennal notch; maxilla 1, palp segment 1 lacking shoulder setae. . . . . 4.

4. Pleosome segments 1-3 very weakly toothed dorsally; coxa 4 deeper than coxa 3; gnathopod 1 (male), propod overhanging and masking small dactyl . . . . . *M. rylovae* Bulycheva.
—Pleosome segments 1-3 dorsally smooth; coxa 4 not deeper than 3; gnathopod 1 (male) propod not distally overhanging or masking dactyl . . . . . *M. hoshinoi* Yamato.

5. Peraeopods 5-7, bases narrow, hind lobes very small; uropod 3, outer ramus slender, elongate (>3X length of peduncle) . . . . . *M. laevidorsum* Stephensen.
—Peraeopods 5-7, bases normally broad, hind lobes normal, distinct; uropod 3, outer ramus normal, length about 2.5X peduncle . . . . . 5.

6. Antenna 2, flagellar segments strongly setose; telson, apical spines short . . . . . *M. setiflagella* Yamato.
—Antenna 2, flagellar segment normally setose or nearly bare; telson, apical spines long . . . . . 7.

7. Peraeopod 5, segment 4, distinctly broadened, width >2/3 length; accessory flagellum very short, 1+ segmented; peraeopods 5-7, dactyls medium strong . . . . . *M. shimizui* Ueno.
—Peraeopod 5, segment 4 normal, little broadened, width about 1/2 length; accessory flagellum regular, 21/2 - 4 segments; peraeopod dactyls short. . . . . 8.

8. Uropod 2, distinctly toothed (and spined) dorsally; coxa 6 (female) modified anterior lobe shallow, weakly "hooked"; .telson with strong lateral spines. . . . . *M. bingoensis* Yamato.
—Uropod 2 not (or very weakly) toothed dorsally; coxa 6 (female) modified, anterior lobe deep, strongly "hooked, posteriorly; telson lobes lacking lateral spines . . . . . 9.

9. Pleon plate 3, hind corner weakly acuminate; urosome 2 very slightly toothed above, with group of 3 spines on each side; gnathopod 1 (male), unguis of dactyl overhangs palm . . . . . *M. nagatai* Yamato.
—Pleon plate 3, hind corner squared or recessed; urosome 2, with spines in groups of 2, lacking teeth; gnathopod 1 (male), unguis of dactyl shorter than palm. . . . . *M. koreana* Stephensen.

Taxonomy commentary (see also Fig. 38).

Most western Pacific species listed above are clearly assignable to the genus *Melita,* as broadly defined, in having strongly sexually dimorphic gnathopod 1 and coxa 6, in lacking facial setae on the inner plate of maxilla 2, and in having a 1-segmented outer ramus of uropod 3. However the most typical members differ from the type species, *M. palmata* (Montagu) in the less strongly narrowed carpus and distally broadened propod of gnathopod 1, and in lacking a dorsal tooth on urosome 1, among other differences.

Two superficially similar Japanese species are particularly enigmatic. *Melita longidactyla* Hirayama, 1987, is clearly aberrant in gnathopod 2 wherein: carpal lobe relatively broad, setose; propod little expanded distally and the palmar margin very weakly toothed; dactyl strongly setose on the outer margin; maxilliped, palp segment 2 broadened medially (not columnar); dactyls of peraeopods 3-7 elongate; and uropod 2, rami subequal in length. Coxa 6 (female) has not yet been described or figured.

Melita tuberculata Nagata, 1965, with similar aberrancies, including a marginally smooth dactyl of gnathopod 2 (male), also has long slender peraeopod dactyls, and the telson lobes have short spines on the outer (lateral) as well as inner margins. The mouthparts and coxa 6 (female) have

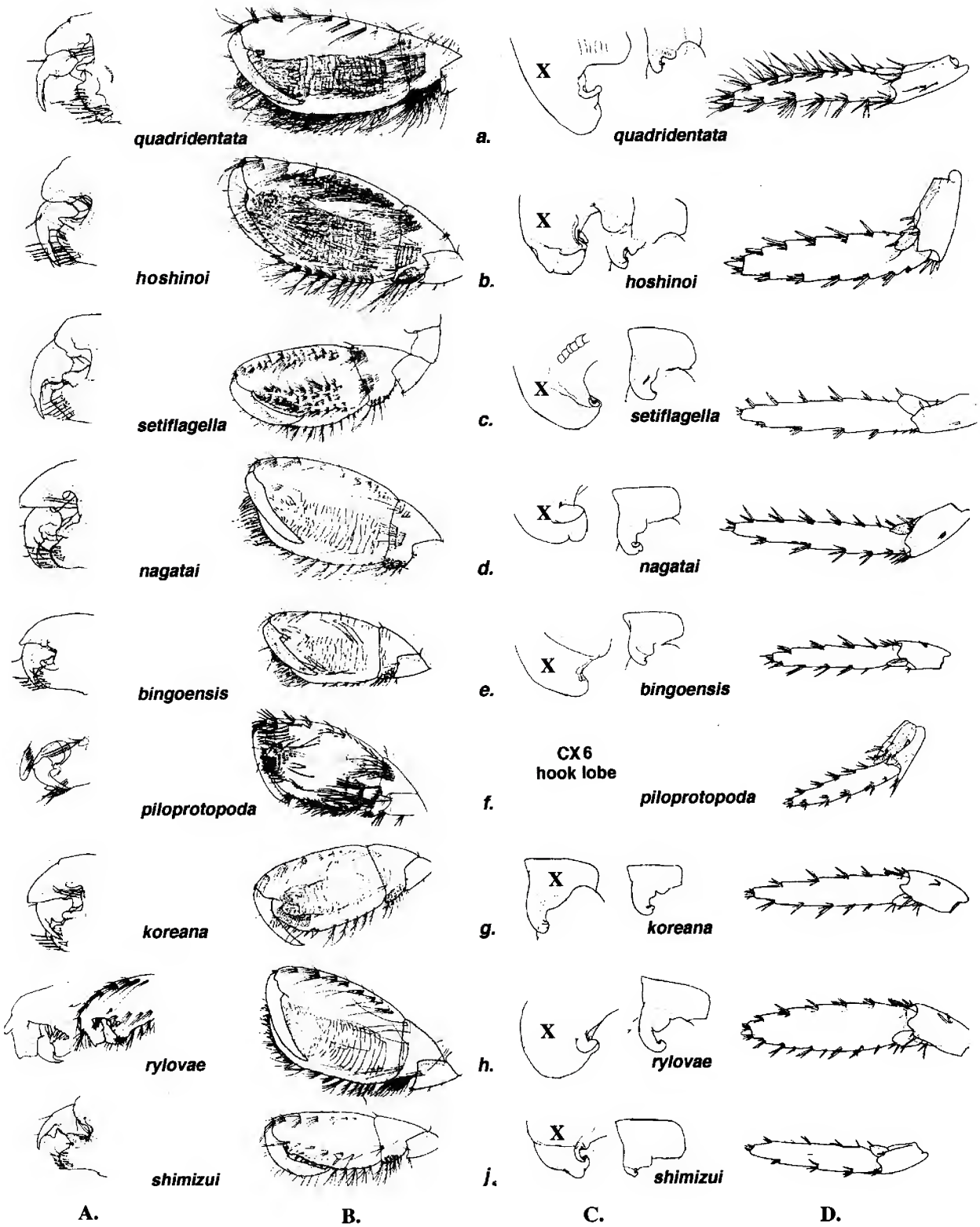

FIG. 38. Character States of Asiatic North Pacific Species of *Melita*: A, B. - Gnathopods 1 & 2 (male); C. - Coxa 6 (female); D. Uropod 3 (male) (Species a, b - after Yamoto, 1990; species c, j - after Yamoto, 1988; species d, e, g, h - after Yamoto, 1987; species f - after Hirayama, 1987).

also not been described. However, *M. tuberculata* differs markedly from *M. longidactyla* in its single dorsal teeth on pleon segments 1-3; the bases of gnathopods 1 & 2 are strongly setose antero-distally, the bases of peraeopods 5-7 do not differ markedly in size or form, and the accessory flagellum is 4-segmented (vs. 2-), among other differences. Pending further study of type and fresh material, in conjunction with re-assessment of the world-wide fauna of *Melita*, both species are candidates for separate generic recognition.

The Asiatic North Pacific species differ from the North Atlantic (type) group of *Melita palmata* in several important taxonomic features that suggest a need for further higher level taxonomic revision. Despite the excellent quality and completness of the work of Japanese authors (above), no material of the several species has been re-examined here, and such revision is beyond the scope of the present study.

Systematic and Biogeographic Analyses.

Some 23 species of the melitid group occur along the Pacific coast of North America. However, the material examined was only moderately extensive, amounting to about 300 species lots (stations), mostly all from rocky shore habitats, but some from subtidal sediments.

The melitid group within family Melitidae has long posed a complex and difficult taxonomic problem. During the past three decades, the difficulty has been greatly compounded by an almost exponential increase in numbers of new species and genera. The increase has resulted mainly from studies on the Indo-Pacific marine fauna (Ledoyer, 1967, etc., Barnard, 1972, etc.), the western North Pacific fauna (e.g., Hirayama, 1987; Yamato, 1990), and the hypogean, anchialine, and interstitial coastal marine faunas mainly of tropical regions (e.g., Stock, 1988, 1990; Vonk, 1988). Karaman (1981) attempted to impart some classificatory order into this growing melange of disparate taxa, with separation of the genus *Abludomelita* from *Melita* sensu *palmata).* However, his analysis was based mainly on a literature search wherein taxonomic characters critical to his diagnoses were not always depicted. Moreover, his diagnoses were based on a very limited number of characters and character states, and he apparently did not recognize, through limited examination of materials, some of the significant features then available (e.g., sexual differences of the gnathopods and coxa 6) that are reproductively (and thus highly) significant in natural classification of component members. The more recent work of Borowsky (1984), Conlan (1990) and others has revealed the behavioural significance of such taxonomic differences between the sexes and species.

The accumulation of extensive previously unstudied material from the North Pacific region has been especially revealing here. As noted above, the material is rich in both species and genera, many of which have proven new to science. Component species have revealed a plethora of previously unrealized characters and character states that have proven significant taxonomically. Some have led to more precise delimiting of Karaman's genus *Abludomelita* both with respect to the genus *Melita* sens. str. and to more closely related genera (p. 8). More correct ordering of these character states also tend to support the validity of other previously proposed natural groupings within the *Melita* group complex (e.g., *Eriopisa* and *Rotomelita* subgroups). Hopefully, however, the present study may provide the framework for revision of the worldwide melitid and hadziid family groups, based on re-examination of actual specimens. Such might compensate for the uneven treatment of critical characters and character states in the existing literature, and hopefully lead to recognition of other significant features.

This study details the systematics and distributional ecology and life styles of species of the *Melita* group previously known and newly discovered on the North American coastal marine region. A UPGMA cluster analysis, modified from that of Sneath and Sokal (1973), is utilized to assess the degree of morphological similarity of the taxa within a larger group taxon. The similarities are based on suitably selected and phyletically ordered character states for the taxa concerned. As explained in previous analyses (e.g., Jarrett and Bousfield, 1994; Bousfield & Hendrycks, 1994), the overall degree of phyletic advancement is indicated by a plesio-apomorphic index derived by summing the values for each character state for each taxon.

As noted above (p. 8), with respect to the "*Abludomelita*" complex of genera, no member of the genus *Abludomelita* Karaman, 1981, sens. str., based on the type species *A. gladiosa* Bate, 1862, has yet been found within the North American Pacific study region. However, some species from the Sea of Japan essentially match this generic diagnosis. The genus *Abludomelita* is here included in a phenogram of morphological relationships of North Pacific genera with the "*Abludomelita*" complex (Fig. 39). The corresponding 20 characters and paired character states are outlined in Table I. Four major groupings of the six generic level taxa occur at or above the 70% similarity level. These include a relatively primitive *Melitoides* group (P.-A. indices of 30-37), that clusters with the enigmatic species *?M. valida* (Shoemaker). These two species are mainly high Arctic in distribution (p. 71). The most advanced genus, *Desdimelita* (on the right), with P.-A. index of 51, clusters most closely with *Abludomelita* (sens. str.), and with a variant of that genus from the Sea of Japan. Near the centre of the chart, the primitive *Quasimelita* group of mainly subarctic and abyssal species, and the more advanced and more speciose arctic-boreal genus *Megamoera,* cluster less closely with the *Abludomelita* subgroup.

The general "vegetative" phyletic thrust within the *Abludomelita* generic complex has apparently proceeded towards specialization of the mouthparts (mainly by decrease in size of plates and palps, reduction of spines and setae), enhancement of the raptorial nature of gnathopod 2, reduction or loss of dorsal abdominal armature, "slenderizing" of the peraeopod bases, and the shortening and basal fusion of the telson lobes. Such direction may duplicate the simplification of mouthparts that apparently took place within the Talitroidea

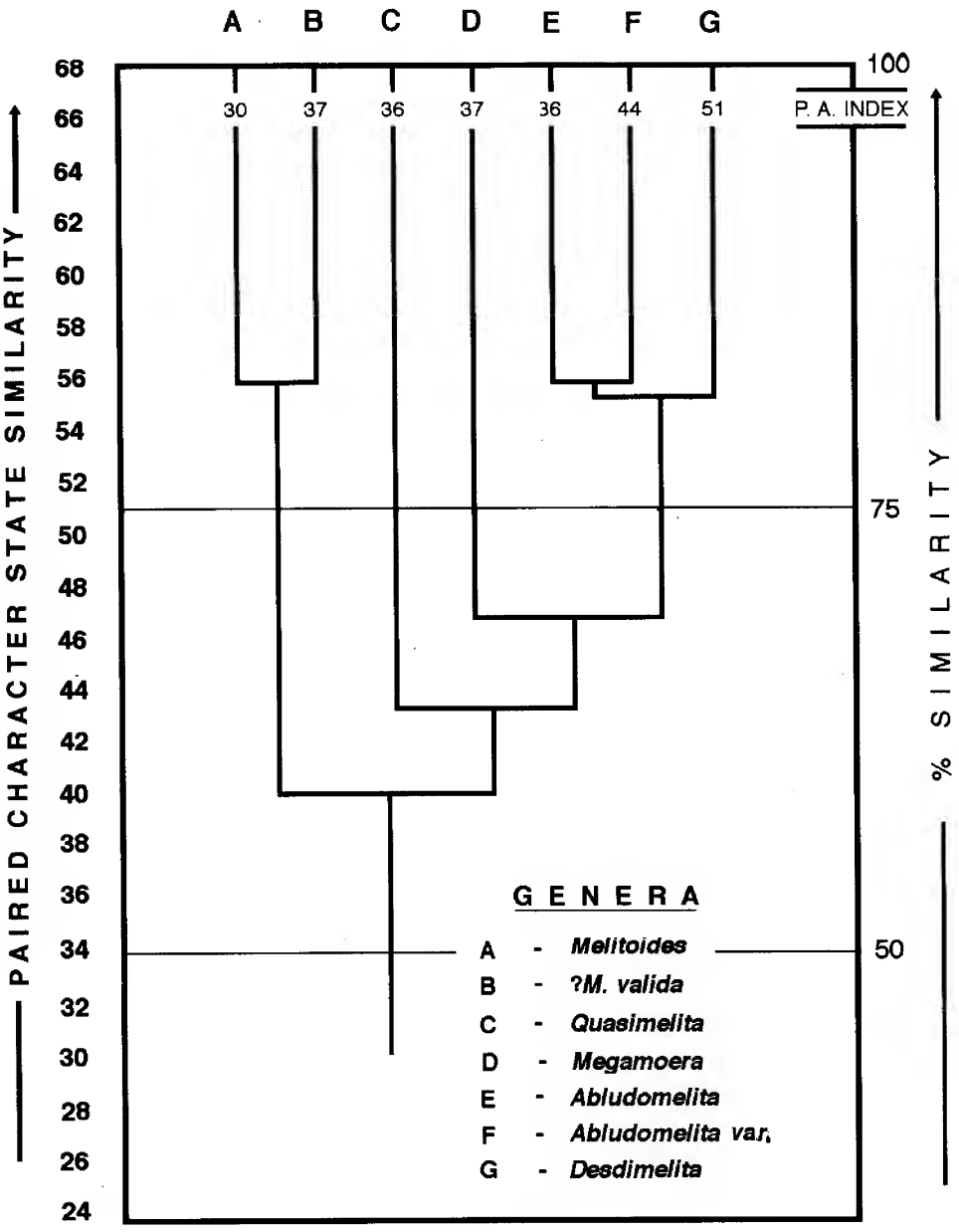

FIG. 39. PHENOGRAM: NORTH PACIFIC *ABLUDOMELITA* GENERIC COMPLEX.

as that group became more benthic, and more specialized for terrestrial and semi-terrestrial, rather than aquatic, food mastication. However, reduction of mouthparts and loss of setation may indicate a shift from a detritivorous or herbivorous feeding mode to a predatory life style. Specialization of the gnathopods for reproductive purposes, outlined above, apparently commenced within the *Abludomelita* complex where early steps in the evolutionary processes may yet be traced in the morphology of extant species. These evolutionary thrusts appear to have reached a pre-amplexing functional culmination in the genus *Melita* sens. str., and an agonistic behavioural (sound-production) apex within the genus *Abludomelita* sens. str. and the related tropical genus *Dulichiella* Stout. Behavioural studies on representative species of this evolutionary series would seem a recommended next step in testing conclusions based primarily on morphological considerations.

Morphological relationships of species groups within the genus *Megamoera* are indicated in Fig. 40. Three major groups within *Megamoera,* relatively closely related, cluster at 65% similarity levels or greater. The subgroups within each subgroup cluster at 70-75% or greater, viz.,(1) a ***subtener*** group, within which are the subgroups *pallida* (1 spp.), and *subtener* (3 spp.); (2) a ***dentata*** (type) group, within which are subgroups *mikulitschae* (1 sp.), *dentata* (2 spp.), and *kodiakensis* (3 spp.); and (3) an ***amoena*** group (aberrant, possibly transitional to *Melitoides.*)

The cluster analysis (above) is based on superficial characters and character states only, as outlined in Table II. The mouthparts are systematically significant but their character states can presently be utilized for only about two-thirds of the species. Full re-examination and redescription

TABLE I. CHARACTERS AND CHARACTER STATES: GENERA OF *ABLUDOMELITA* GROUP

CHARACTERS	CHARACTER STATES		
	Plesiomorphic 0	**Intermediate 1**	**Apomorphic 2**
1. Pleon segment 3, postero-dorsal teeth	strong	weak	lacking
2. Urosome segment 1, postero-dorsal teeth	strong	single	lacking
3. Urosome 2, postero-dorsal teeth	4, strong	4, weak	2 only
4. Antenna 1, accessory flagellum, number of segments.	5-6	4	2-3
5. Anterior head lobe, inferior marginal accessory lobe	lacking	weak	strong
6. Mandibular palp, segments 2 & 3, relative lengths	2>3	2=3	3>2
7. Maxilla 1, palp segment 1, number of lateral setae	0-2	3-5	6+
8. Maxilla 2, inner plate, facial setae	strong	reduced	weak, submarg.
9. Maxilliped palp, segment 2	very broad	sl. expanded	columnar
10. Gnathopod 1, degree of sexual dimorphism	0	slight	marked
11. Gnathopod 2, setation of dactyl	0-very slight	moderate	heavy
12. Gnathopod 2 (male), breadth of carpus	wide, lower margin setose	medium	narrow
13. Coxa 1, distal broadening	none	slight	pronounced
14. Coxa 4, depth relative to coxae 1-3	deep	subequal	shallow
15. Peraeopods 5-7, width of bases	very broad lobes distinct	normal breadth lobes regular	narrow lobes small
16. Peraeopods 5-7, size of dactyls	very small	medium small	medium, long
17. Pleon plate 3, hind corner	strongly produced	slightly produced	quadrate
18. Uropod 1, ramal spines	numerous		few (2-3)
19. Uropod 3, size of terminal segment of outer ramus	large, normal	small	lacking
20. Telson lobes, strength of distal marginal notches	strong, deep	small, shallow	lacking

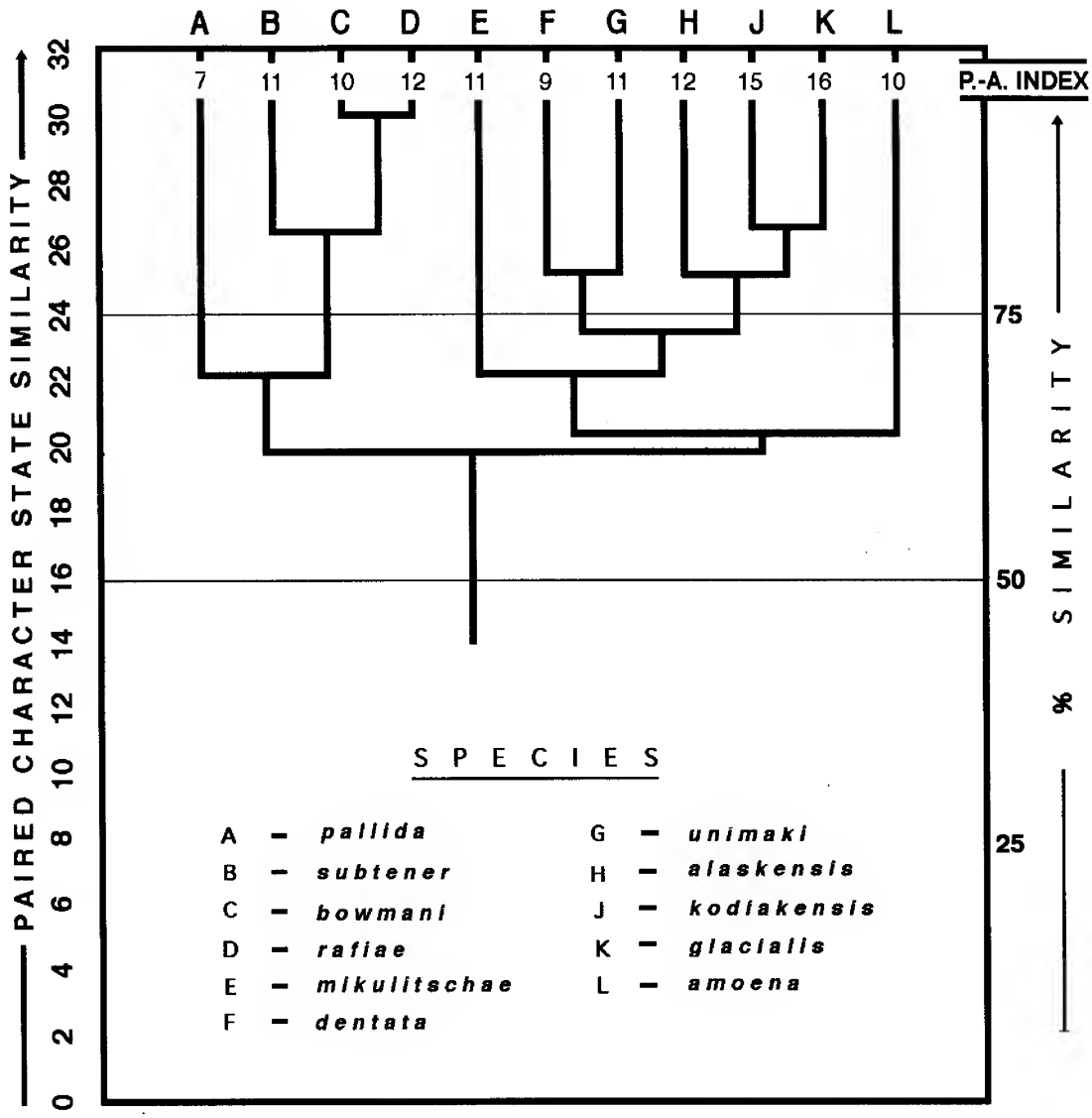

FIG. 40. PHENOGRAM: MAINLY NORTH PACIFIC SPECIES OF *MEGAMOERA*..

of those species, including both sexes where possible, is indicated for the solution of mouthpart relationships.

Taxonomic groupings within genus *Megamoera* are in concordance with distributional patterns of component species (Table IV). Thus, the *subtener* group is mainly North American; the *dentata* group is mainly Arctic and subarctic North American Pacific, but a few species also penetrates the Sea of Okhotsk and northern Japan Sea in the Asiatic subarctic. The *amoena* group is relatively primitive, and occurs in deeper shelf and slope waters.

Members of the *subtener-dentata* groups are closely related, all within 65%morphological similarity level and all but one (*M. pallida*) recorded within the North Pacific shelf region. More detailed taxonomic information is needed for precise placement of the *amoena* subgroup. *M. amoena* is perhaps surprisingly similar to *"Melita" lignophila* J. L. Barnard, and may form a relatively primitive connecting link with the western Pacific subgroup of *Abludomelita* (p. 10).

Cluster analysis of species within the genus *Melita* reveals relationships depicted in the phenogram of Fig. 41 (p. 68). At least 16 species of *Melita* occur in the North Pacific region of which 12 (including variants) occur along Asiatic shores and 4 along North American coasts. Distributionally, these occur in the southern parts of both coasts and appear to be limited northwards, on both coasts, possibly by thermal requirements for reproduction in this typically warm-water genus, but also by competition with the more diverse northerly and phyletically more primitive *Abludomelita* complex of genera and species.

Four major subgroups, each with components clustering internally at or above the 70% similarity level, and all 4 groups relatively closely related to each other, clustering at or above 60% similarity level, are as follows:
(i) a primitive *hoshinoi* group (Sea of Japan), with 2-segmented outer ramus of uropod 3, small postero-dorsal pleonal teeth, and hind corner of pleon plate 3 acutely produced.

TABLE II. CHARACTERS AND CHARACTER STATES: SPECIES OF *MEGAMOERA*.

CHARACTERS	CHARACTER STATES		
	Plesiomorphic 0	**Intermediate 1**	**Apomorphic 2**
1. Head, anterior lobe, super-numerary process	absent		present
2. Accessory flagellum, number of segments	5-6	4	2-3
3. Coxa 1, distal expansion	little		broadly
4. Gnathopod 1, degree of sexual dimorphism	barely discernible		distinct
5. Gnathopod 1, basis, antero-distal setae	weak		strong
6. Gnathopod 2, propod palmar teeth	lacking	weak	strong
7. Gnathopod 2 (male), dactyl, outer marginal setae	lacking		strong
8. Gnathopod 2, carpus	broad, distinct		short, deep
9. Peraeopods 3-4, dactyls	very short	short	medium to long
10. Peraeopods 5-7, bases	very broad	broad	rel. narrow
11. Peraeopod 6 (female), coxa, anterior lobes bifid	little or not		conspicuously
12. Pleon plate 3, hind process, accessory marginal teeth	lacking	weak	distinct
13. Pleon segment 3, dorsum, postero-distal teeth	strong	weak	lacking
14. Urosome 1, dosral teeth	strong/ 3+		weak/single
15. Uropod 3, outer ramus, no. of lateral spine clusters	6-7	4-5	2-3
16. Telson, inner margin spines	lacking	trace	2-3

(ii) an intermediate type (*palmata*) group, one representative only (*M. sulca*) on the North American Pacific coast.
(iii) a large, advanced, *nagatai* group, with 7 members, 5 in Asiatic region, 2 (*oregonensis-alaskensis*) in North America
(iv) a disparate, advanced *nitida* group of 2 species, 1 (*nitida*) introduced from the Atlantic coast to the North American Pacific region (Chapman, 1988), and the unique *M. laevidorsum* of the Asiatic Pacific coast.

Several distinct types of "*Melita*" are represented here, all candidates for further phyletic and classificatory analysis. However, material was not available and such analysis is beyond the scope of the present study.

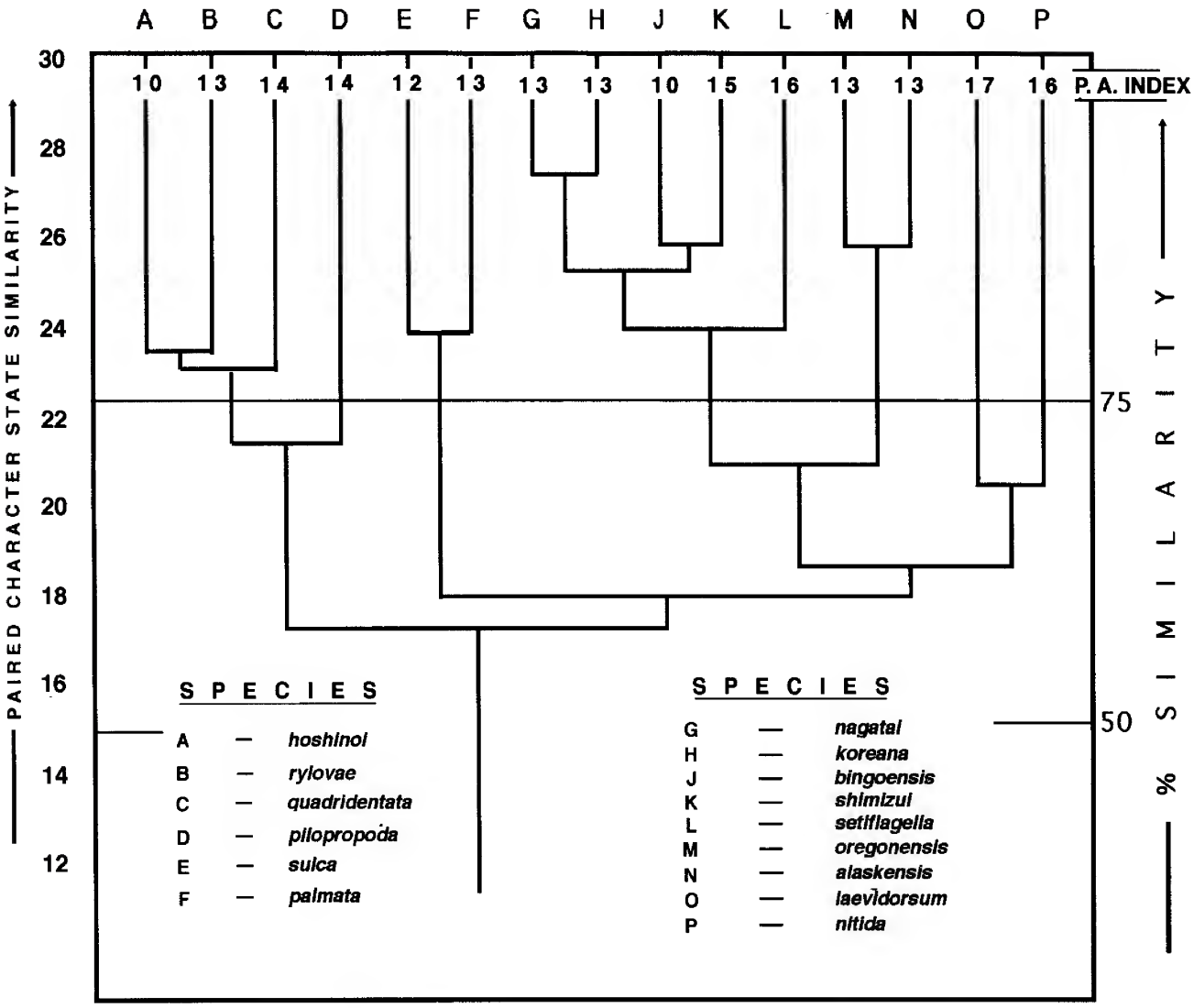

FIG. 41. PHENOGRAM: NORTH PACIFIC SPECIES OF *MELITA* LEACH.

BIOGEOGRAPHICAL ANALYSIS

The North Pacific intertidal and subtidal melitid fauna contains 39 species in 6 genera of which the *Abludomelita* complex contains 23 species in 5 genera, and the *Melita* subgroup 16 species in genus *Melita* (Table IV, p. 72). Within the *Abludomelita* complex, species of three genera (*Megamoera, Melitoides,* and *Quasimelita*) are essentially arctic and subarctic in distribution, whereas species of the other two genera (*Abludomelita* and *Desdimelita)* are essentially boreal or cold temperate. These have not authentically been recorded either from the Bering Sea to the north, or the warm temperate waters of California and Sea of Japan to the south.

Of the 9 regional species within genus *Megamoera,* only 2 species (*M. dentata* and *M. mikulitschae*) are known from the Asiatic coast, whereas all nine species (7 endemic) have been taken along North American Pacific shores. Greatest species diversity was found in southeastern Alaska (zone 4). The four regional species of *Melitoides* and *Quasimelita* have not been recorded south of the Bering and Okhotsk Seas. Members of these three genera tend to occur deeply subtidally, where their powerfully toothed gnathopods and reduced setation of maxilla 2 suggest a mainly predatory, rather than detritivorous or herbivorous life style.

By contrast, the four species of *Abludomelita* var. are narrowly endemic to the northern and central Sea of Japan. The six species of its counterpart genus, *Desdimelita,* are endemic to the North American Pacific coast, from southeastern Alaska to central California, with greatest species diversity from southern British Columbia to Washington and Oregon. As in *Dulichiella,* the well developed facial setae of maxilla 2 may suggest an essentially detritivorous life style.

Within the genus *Melita,* all 12 known species of the Asiatic North Pacific coast, and all four species of the North American coast are regionally endemic. Component subgroups are not closely related (phenogram, fig. 41). Only one species of the Asiatic coast *(M. setiflagella)* shows close similarity, in some character states, with one species of the

TABLE III: CHARACTERS AND CHARACTER STATES: SPECIES OF *MELITA*

CHARACTERS	CHARACTER STATES		
	Plesiomorphic 0	**Intermediate 1**	**Apomorphic 2**
1. Urosome 1, dorsal tooth	Present	trace	lacking
2. Urosome 2, number of dorsal teeth	4	2	0
3. Urosome 2, number of dorsal spines on each side	3-4	2	1
4. Antenna 1, peduncular segment 1 no. of posterior marginal spines	2	4	6
5. Antenna 2, flagellar segments "bottle brush" setation	weak	medium	strong
6. Mandibular palp, segment 3 setation	normal, strong		very weak
7. Maxilla 1, number of inner plate inner marginal setae	9-10	7-8	5-6
8. Peraeopods 5-7, size of dactyls	very short	medium	long, strong
9. Peraeopod 5, segment 4 expansion	normal width< 1/2 length		broad width = 2/3 length
10. Peraeopod 6, coxa (female) form of anterior lobe	shallow weakly "hooked"		deep strongly "hooked"
11. Peraeopods 5-7, form of basis	uniformly broad		narrowing
12. Peraeopods 5-7, segments 5-6. armature	hind lobe normal spines only		hind lobe small setae & spines
13. Uropod 1, size of distal peduncular spine	small	medium	large, strong
14. Uropod 3, outer ramus, terminal segment	present, distinct	small	lacking
15. Telson, apical spines	long, strong		short, weak

North American coast (*M. nitida*). However, the phenogram (above) would suggest that the two species are similar at the 60% level only, and thus not very closely related.

Most species of *Melita* are intertidal and shallow subtidal in depth range and occur frequently in under-rock habitats. However, in two species (*M. longidactyla, M. pilopropoda*) the basis and segment 4 of peraeopods 5-7 are much broadened, and the dactyls elongate, perhaps indicating a preference for sedimentary habitats at greater depth.

The 12 species of the genus *Melita* dominate temperate and warm temperate regions of the Sea of Japan. Similarly, two of the four species of *Melita* on the North American Pacific coast, *M. sulca* and *M. nitida*, occur only in summer warm waters , from southern California sporadically northward to the Strait of Georgia. These show closer similarity to North Atlantic species. The other two species, *M. oregonensis* and

M. alaskensis, with closer morphological similarity to the Asiatic Pacific fauna, occur mainly in cold-temperate waters, from central California north to southeastern Alaska.

The relatively primitive *Abludomelita* complex appears much more diverse in the North American than the Asiatic Pacific coastal marine region. Member species exhibit intermediate stages in evolution of the sexually dimorphic gnathopod 1 and coxa 6, and unique precopulatory "carrying" behaviour first described by Borowsky (1984), that attains a maximum degree of complexity within the genus *Melita* Leach. The North Pacific thus appears to be a centre of origin and evolution for the entire *Melita* group of genera and species. The group appears to be the most advanced subgroup within family Melitidae (p. 6) and perhaps one of the more recent invaders of regional under-rock habitats, even in competition with a very diverse regional cold-water anisogammaridan fauna (Bousfield, 1979). The relationship of melitid species to the two relict species of Mesogammaridae in the North Pacific region is obscure, but is probably convergent both in form and ecological preference.

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TABLE IV. DISTRIBUTION OF SPECIES OF THE *ABLUDOMELITA* AND *MELITA* GENERIC COMPLEXES IN THE NORTH PACIFIC REGION.

TAXON	BIOGEOGRAPHICAL ZONE								
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Megamoera Bate									
mikulitschae (Gurjanova)		X	X						
dentata (Kroyer)	?	?	X	?					
unimaki, new species			X						
rafiae, new species				X					
glacialis, new species				X					
borealis, new species,				X					
kodiakensis (J. L. Barnard)				X					
bowmani, new species				X	X				
subtener (Stimpson)				X	X	X	x?		
Melitoides Gurjanova									
makarovi Gurjanova		X	X						
valida (Shoemaker)?			X						
Quasimelita, new genus									
quadrispinosa (Vosseler)		X	X						
formosa (Murdoch)			X						
Abludomelita Karaman, var.									
somovae (Bulycheva)	X	?							
japonica (Nagata)	X	?							
denticulata (Nagata)	X	?							
unamoena (Hirayama)	X	?							
sexstachya (Gamo)	X								
Desdimelita, new genus									
microphthalma, new species				X					
microdentata, new species				X	X	X	X		
desdichada (J. L. Barnard)				x	X	X	X	X	
californica (Alderman)					X	X	X	X	
barnardi, new species					X				
transmelita, new species						X			
Melita Leach									
Western North Pacific com-	X								
plex of 12 species of *Melita*	X								
alaskensis, new species				X					
oregonensis J. L. Barnard					X	X	X		
nitida Smith					X	X	X	X	
sulca (Stout)					x	X	X?	X	X

BIOGEOGRAPHICAL ZONES

1. Sea of Japan; 2. Sea of Okhotsk; 3. Bering Sea & Aleutians; 4. Southeastern Alaska; 5. Northern B. C.; 6. Southern B. C.; 7. Washington-Oregon; 8. Northern & Central California; 9. Southern & Baja California

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LEGEND FOR FIGURES

A1	-	antenna 1	IN.	-	inner face	PLEOS	-	pleosome
A2	-	antenna 2	I. P.	-	inner plate	PLP	-	palp
ABD	-	abdomen	LFT	-	left	PLP 1-3	-	pleopods 1 - 3
AC. Fl.	-	accessory flagellum	LL	-	lower lip	RDGS.	-	ridges
CX	-	coxal plate	MD	-	mandible	RT	-	right
DCTL	-	dactyl	MX1	-	maxilla 1	SEG	-	segment
DORS	-	dorsal	MX2	-	maxilla 2	STR.	-	stridulating
EP 1-3	-	epimeral plates 1-3	MXPD	-	maxilliped	T	-	telson
GN1	-	gnathopod 1	O. P.	-	outer plate	U1-3	-	uropods 1-3
GN2	-	gnathopod 2	OUT.	-	outer face	UL	-	upper lip
HD	-	head	P 3-7	-	peraeopods 3-7	UROS	-	urosome
IMM.	-	immature	PLEON	-	pleon			

THE AMPHIPOD FAMILY OEDICEROTIDAE ON THE PACIFIC COAST OF NORTH AMERICA. I. THE *MONOCULODES* & *SYNCHELIDIUM* GENERIC COMPLEXES: SYSTEMATICS AND DISTRIBUTIONAL ECOLOGY

By E. L. Bousfield[1] and Andrée Chevrier[2]

ABSTRACT

The gammaridean amphipod crustacean family Oedicerotidae is represented on the Pacific coast of North America by 29 species of the *Monoculodes* generic complex [= *Monoculodes* Stimpson, 1853 (sens. lat.)] and 8 species of the *Synchelidium* generic complex [= *Synchelidium* Sars, 1895 (sens. lat.), and related genera]. The genus *Monoculodes* is here rediagnosed and restricted on the basis of Stimpson's original treatment of the genus and his type species, *M. demissus,* from the North American Atlantic region. The *Monoculodes* complex is subdivided into several natural genera of which the following taxa occur in the study region, from the Bering Sea to northern California: *Monoculodes* Stimpson, 1853, encompassing *M. latimanus* Boeck, 1871; *M. emarginatus* J. L. Barnard, 1962, *M. perditus* J. L. Barnard, 1966; ***M. brevirostris***, new species; *M. castalskii* Gurjanova, 1951; and *M. diamesus* Gurjanova, 1951; ***Deflexilodes***, new genus [Type species - *D. tenuirostratus* (Boeck, 1871)], including ***D. similis***, new species; ***D. enigmaticus***, new species; and *D. tuberculatus* (Boeck, 1871); *Monoculopsis longicornis* Sars, 1895; ***Pacifoculodes***, new genus, including its type species *P. spinipes* (Mills, 1962); ***P. bruneli,*** new species; ***P. barnardi,*** new species; ***P. levingsi***, new species, *P. zernovi* (Gurjanova, 1938); and *P. crassirostris* (Hansen, 1887, fide Gurjanova, 1951.).

The following, mainly extralimital genera of the *Monoculodes* complex are diagnosed, and North Pacific regional species are keyed: ***Ameroculodes***, new genus [(Type species- *A. edwardsi* (Holmes, 1905)]; ***Hartmanodes***, new genus [Type species- *H. hartmanae* (J. L. Barnard, 1962)]; ***Limnoculodes,*** new genus [Type species- *L. limnophilus* (Tattersall, 1922)]; and ***Rostroculodes,*** new genus [Type species - *R. longirostris* (Goes, 1866)]. *Kroyera* Bate, 1857, is revived to encompass the distinctive European Atlantic type species *K. carinata* Bate, 1857.

The *Synchelidium* generic complex is here subdivided into *Synchelidium* Sars, 1895 (sens. str.)[Type species - *S. haplocheles* Grube, 1864]; ***Eochelidium,*** new genus [Type species- *E. lenorostralum* (Hirayama, 1986)]; *Chitinomandibulum* Jo, 1990 [Type species - *C. emargicoxa* Jo, 1990]; and ***Americhelidium***, new genus [Type species - *A. shoemakeri* (Mills,1962)]. The following North American Pacific species of *Americhelidium* are diagnosed: *Americhelidium rectipalmum* (Mills, 1962); *A shoemakeri* (Mills, 1962); ***A. setosum***, new species; ***A. millsi***, new species; ***A. pectinatum***, *new species*; and ***A. variabilum***, new species. *Americhelidium micropleon* (Barnard, 1977) from the eastern North Pacific, and *A. gurjanovae* (Kudrjaschov & Tzvetkova, 1975), and *A. latipalpum* (Hirayama, 1986) from the western North Pacific, are also keyed.

Biogeographically, within the *Monoculodes* generic complex, the eastern and western North Pacific regions contain about equal numbers of species, but of very different generic composition. The *Monoculodes* complex is almost exclusively arctic and arctic-boreal, but a few species of the primitive genus *Monoculodes* Stimpson (sens. str.) are recorded from antiboreal regions. The *Synchelidium* complex is much more diverse in the western North Pacific where it contains 7 species of *Eochelidium,* and representatives of the genera *Chitinomandibulum* Jo, *Perioculodes* Sars, *Pontocrates* Boeck, *Hongkongvena* Hirayama, and *Sinoediceros* Shen. The eastern North Pacific reveals only 8 species, within *Americhelidum* and *Finoculodes* J. L. Barnard.

INTRODUCTION

On the Pacific coast of North America, knowledge of the systematics and distributional ecology of oedicerotid amphipods has been fairly well established for the California region. Studies by the late J. L. Barnard (1961, 1962, 1966, 1967, 1969b, 1971, 1975, 1977, etc.) encompassed several species of *Monoculodes, Bathymedon, Synchelidium* and other genera, especially in the region south of Pt. Conception. From the central region of Washington through British Columbia to southeastern Alaska, the study of Mills (1962) provided detailed systematic knowledge of two species of *Monoculodes,* two of *Synchelidium,* and one of *Westwoodilla.* Previous individual records of *M. zernovi* from Washington State by Weiser (1959), and of M. *carinatus* Bate from Puget Sound by Wailes (1931), may be unverifiable. Staude (1987) rounded out the limited total from the central region with records of two species of *Bathymedon,* both described previously by Barnard from more southerly waters. Records from the Bering Sea-Alaska mainland region are equally sparse, and are represented mainly by *Macheironyx muelleri* Coyle, 1980,and by the amphipod listings of Slattery (pers. communic.), including species of *Monoculodes* and *Bathymedon.* Shoemaker (1955) recorded several high arctic genera and species of oedicerotids from Pt. Barrow, Alaska, slightly north of the present study region.

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Oedicerotid amphipods of the northwestern Pacific region, including the Sea of Okhotsk, Japan, western Bering and Chukchi Seas, are also fairly well known through the studies of Gurjanova (1936, 1938, 1951, et seq.), Bulycheva (1952), and Kudrjaschov & Tzvetkova (1975). Nagata (1965), Hirayama (1986, 1987, 1992), Morino (1990), Jo (1990), Ishimaru (1994) and others have recorded a rich oedicerotid fauna from Japan, Korea, and the coast of China south to Hong Kong.

The present study, involving several hundred species-lots from more than 200 stations, attempts to amplify knowledge of the systematics and distributional-ecology of the oedicerotid supergenera *Monoculodes* and *Synchelidium* in the northwestern Pacific region and establish their relationships with the better known faunas to the south and to the northwest of the study region.

The systematics of the genus *Monoculodes* represents a special taxonomic challenge in Carcinology. Prior to the present study, more than 50 species of the genus had been recorded from coastal shelf and bathyal waters, almost exclusively from cold-water regions of the northern hemisphere. Much of the early work, notably by Boeck (1871), Sars (1895), and Stebbing (1906), and more recently by Stephensen (1931), Gurjanova (1951), and Ledoyer (1993), was based on the fauna of northwestern Europe. Frequently, the original descriptions are incomplete and do not treat (or figure) taxonomically significant features of the mouthparts, uropods, coxal gills and/or brood plates The type of the genus, *Monoculodes demissus*, was only briefly diagnosed and not figured by Stimpson, 1853, and further material has never been identified nor redescribed. Its detailed taxonomic status is therefore only marginally, but legitimately, definable. However, the enormous wealth of material that accrued from the field materials above has facilitated the solution of many of these problems. We leave the degree of credibility and usefulness of the results to be decided by our reviewers, and by future students of the group.

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SYSTEMATICS

Oedicerotidae Liljeborg, 1865

Oedicerotidae Liljeborg, 1865: 18.—Stebbing, 1906: 235. —Gurjanova, 1951: 518.—Lincoln, 1979: 336;—Barnard & Barnard, 1991: 547.—Ishimaru, 1994: 61.—Ledoyer, 1993: 579.
Oedicerotoidea (part)—Bousfield, 1982: 265.

Type Genus: *Oediceros* Kroyer, 1842: 155.—Stebbing, 1906: 243.

Component North Pacific Genera. *Acanthostepheia* Boeck, 1871: 163; *Aceroides* G. O. Sars, 1895: 340; *Arrhis*, Stebbing, 1906: 248, 726; *Bathymedon* G. O. Sars, 1895: 332; *Chitonomandibulum* Jo, 1990; *Cornudilla* Barnard & Karaman, 1991: 557; *Finoculodes* J. L. Barnard, 1971: 49; *Hongkongvena* Hirayama, 1992: 140; *Machaironyx* Coyle, 1980: 197; *Monoculodes* Stimpson, 1853: 54; *Monoculopsis* G. O. Sars., 1895: 310; *Oediceroides* Stebbing, 1888: 843; *Oediceropsis* Liljeborg, 1865: 10; *Paroediceros* G. O. Sars, 1895: 291; *Perioculodes* Sars 1895: 312; *Pontocrates* Boeck, 1871: 171; *Sinoediceros* Shen, 1955: 85; *Synchelidium* G. O. Sars, 1895: 317; *Westwoodilla* Bate, 1857: 139.

Diagnosis of the family. Body smooth, occasionally dorsally toothed or carinated. Peraeon segments short, compressed, coxae deep. Pleon segments large, plates large, deep. Head large, rostrum usually strongly developed, with acute, often deflexed apex. Eyes large, typically fused mid-dorsally at base of rostrum, often sexually dimorphic, lacking in some bathyal forms. Antennae medium, sexually dimorphic, aesthetascs and brush setae (but rarely calceoli) present in males. Antenna 1 usually shorter than antenna 2, lacking accessory flagellum.

Upper lip rounded or slightly indented below. Lower lip broad, inner lobes variously separated or fused medially. Mandible, molar usually large, titurative, or reduced to a small spinose nubbin; incisor variously toothed, occasionally smooth; palp slender, 3-segmented, often weakly setose. Maxilla 1, inner plate with few apical setae; outer plate 7-9 spinose, palp 2-segmented. Maxilla 2, plates small, weakly armed. Maxilliped strong; inner plates small; outer plates large, with inner marginal masticatory spines; palp stout, strongly dactylate.

Gnathopods 1 & 2 usually strongly subchelate, occasionaly cheliform, trending to dissimilarity in size and form, rarely sexually dimorphic; carpal lobes variously produced postero-distally, tending to guard the hind margin of the propod.

Peraeopods fossorial; in paired combinations of short subsimilar peraeopods 3 & 4, subsimilar peraeopods 5 & 6, and large, elongate peraeopod 7, with elongate dactyl. Dactyls of peraeopods 3-6 large to very small, nails often with apical chitinous rings.

Pleon plates 2 and 3, hind corners usually obtuse or broadly rounded, rarely acutely produced. Pleopods strong, sexually dimorphic. Uropods 1-3 slender, with strong peduncles and slender, subequal, weakly armed, acute rami that lack apical spines.

Telson short, subrectangular, entire, apical margin gently rounded, subtruncate or weakly incised; penicillate setae distal.

Coxal gills large, sac-like, on peraeopods 2-6. Brood plates narrow, strap-like,with elongate marginal setae.

Taxonomic and Distributional commentary. The phyletic placement of family Oedicerotidae within superfamily Oedicerotoidea, and within reproductively free-swimming superfamilies of gammaridean Amphipoda, is treated by Bousfield & Shih (1994). An updated key to world genera of family Oedicerotidae is provided by Barnard & Karaman (1991).

Family Oedicerotidae comprises about 200 described species in 35 genera, numbers that are increased by about 10% as a result of the present study of the North Pacific fauna The group is essentially arctic and arctic-boreal in distribution, ranging into the deep sea and Antarctic deep shelf and bathyal waters, with a few warm-temperate and subtropical representatives in oceans of the northern hemisphere.

The *Monoculodes* and *Synchelidum* generic complexes: distinctive features. These two generic macrogroupings represent the most advanced stages of evolutionary thrust within family Oedicerotidae. In both groups, the gnathopods trend towards elongation of the propod and corresponding elongation of the sensory posterior carpal lobe which, in the most advanced condition, becomes fused with the posterior margin of the propod. The carpus, propod and dactyl thereby form an attenuated subchelate or cheliform appendage that serves in deposit feeding (Enequist, 1949), or detecting and capturing small prey organisms (e.g., foraminiferans) within soft bottom sediments. A burrowing function is also not inconceivable. Early and intermediate stages in this evolutionary sequence are here demonstrated within various genera of the *Monoculodes* complex; later stages of the series typify various genera of the *Synchelidium* complex.

The mouthparts differ strongly (see Enequist, 1949; and below). In the *Monoculodes* complex, the mandibular molar is essentially large and triturative in function. In the *Synchelidium* complex, the molar is much reduced, nubbin-like, and bears apical spine(s) that may function as additional blade(s) of the spine row.

Other morphological differences are more apparent. Monoculodids tend to be larger in size (8-20+ mm) whereas synchelidiids are small, few exceeding about 6 mm in body length. Many species of monoculodids, esp. within genus *Monoculodes* sens str., lack pigmented eyes, whereas the eyes of all known synchelidiids (except *Finoculodes*) are essentially pigmented.

A major distributional difference, as noted below, is that *Monoculodes* group members are predominantly arctic and arctic-boreal, with relatively few species penetrating warm-temperate and tropical surface waters. They also occur at bathyal depths in northern and southern hemispheres. By contrast, syncheliid components are almost exclusely warm-temperate and tropical in the northern hemisphere. Members are restricted almost exclusively to the eulittoral zone; none (except *Finoculodes*) is bathyal.

Monoculodes Stimpson (sens. lat.)

Monoculodes Stimpson, 1853: 54.—Sars, 1895: 294.—Stebbing, 1906: 258.—Gurjanova, 1951: 562.—Barnard, 1969: 383.—Lincoln, 1979: 349.—Barnard & Karaman, 1991: 559.—Ledoyer, 1993: 587.

Type species. *Monoculodes demissus* Stimpson, 1853, monotypy.

Genera. *Monoculodes* Stimpson, 1853; *Hartmanodes,* new genus; *Rostroculodes,* new genus; *Deflexilodes,* new genus; *Limnoculodes,* new genus; *Ameroculodes,* new genus; *Kroyera* Bate, 1857 (revived status); *Pacifoculodes,* new genus; *Monoculopsis* Sars, 1895.

Taxonomic commentary: The genus *Monoculodes* has been defined (authors above) to encompass oedicerotids that have medium to large subchelate gnathopods in which the carpal lobes are variously enlarged and directed distally, often closely guarding (but not fused with) the posterior margin of the propod. Such a broad definition has included several very distinct species complexes that in other taxonomic family groups (e.g., Gammaridae) would long ago have been given separate generic status (see Bousfield, 1977).

Revision of this large and unwieldy genus has been been complicated by the growing number of world species included under the generic name *Monoculodes*, the lack of a rigorously defined type species or extant type specimen that can be

rediagnosed, and the lack of material from broad regions of distribution of the entire species complex. Few original authors have treated the mouthparts in any detail, and these are, potentially at least, of phyletic and classificatory significance,

Barnard and Karaman redefined the genus based on *Monoculodes carinatus* Boeck, a species that has been described and figured in detail (e.g., by Sars, 1895; Ledoyer, 1993). Unfortunately, and as shown below, *M. carinatus* does not conform with many of the generic features listed by Stimpson (loc. cit.) nor does it occur even broadly within the North American Atlantic region, let alone near the nominate type locality. The authors have therefore reassessed and revalidated Stimpson's original diagnosis of the genus *Monoculodes* and its type species *M. demissus.*

Principal diagnostic features within genera of the *Monoculodes* complex are illustrated in Figure 1. Such features have been variously utilized in keys to regional and world species groups, notably by Gurjanova (1951), J. L. Barnard (1962), and Bousfield (1973), among others. Here the features are arranged in roughly phyletic series, trending generally from a plesiomorphic condition (top) to an apomorphic state (bottom). Plesio-apomorphic assessment of character states is derived from comparison with more primitive outgroup oedicerotoidean families such as the calceolate Exoedicerotidae and Paracalliopiidae that are almost exclusively austral, littoral and/or estuarine in distributional ecology (Bousfield, 1982; Barnard & Karaman, 1991).

With respect to the structure of the rostrum, the plesiomorphic condition is a relatively straight-tipped process, the apex acute and relatively little deflexed, with dorsally approximated eyes located basally, mainly on the head proper (e.g., D, E, H) or more distally on the rostrum (A, B, J). In a more advanced condition, the rostral apex is strongly deflexed (e.g., F, G) and, in the most advanced state, the apex is subtruncate and the eye apical (e.g., C).

With respect to gnathopod 1, in the most plesiomorphic condition of the carpus, the anterior margin is elongate and the carpal lobe is short, not reaching the palmar angle (e.g., A, B, C, D), intermediate in barely reaching the palmar angle (e.g., E, F, G,), and advanced in exceeding the palmar angle (e.g., H, J). The propod, plesiomorphically, is relatively short and broad (deep) (e.g., A, B, C, E), but is apomorphically elongate and relatively narrow (e.g., D, F, H, J). The posterior margin of the propod, in more advanced state, may be slightly deflexed distally, resulting in a slightly concavity of the posterior margin (e.g., B, G, H (some), J).

Similar trends are discernible in gnathopod 2. However, the carpal lobe is always more slender and attenuated and, in the more advanced state, it closely approximates ("guards") the posterior margin of the propod (e.g., F, G, H) which distally narrows in the most advanced condition (e.g., J).

With respect to peraeopods 1 & 2, in the plesiomorphic condition, the distal segments (4-6) are slender and weakly setose and the dactyls are relatively long and slender (e.g; A, B, D). In the apomorphic condition, segment 4 (especially) is distally broadened and strongly setose, and the dactyls are short (e.g., E, G, H, J). These states are intermediate in other genera (e.g., C, F). In the plesiomorphic state, segment 5 is more elongate than segment 6 (e.g., D, E, H, J,) but shorter than segment 6 in the advanced state (e.g., A, B, C, F, G) With respect to the basis of peraeopod 7, in the plesiomorphic condition the proximal portion is relatively narrow, and the posterior (lower) lobe is vestigial or lacking (e.g., A, B, C , F, G). In the advanced state, the basis is broad and the posterior lobe well developed, often deeper than the ischium (e.g., D, E, H, J).

Monoculodes Stimpson (sens. str.)

Monoculodes Stimpson, 1853: 41.
Monoculodes Stimpson (part) Sars, 1895: 294.—Stebbing, 1906: 258.—Shoemaker, 1930: 60.—Bousfield, 1973: 95.—Barnard & Karaman, 1991: 559.

Type species: *Monoculodes demissus* Stimpson, 1853: 41, monotypy.

Species (Northern hemisphere): *Monoculodes brevirostris*, new species (p. 89); *M. castalskii* Gurjanova, 1951; *M. coecus* Gurjanova, 1946; *M. diamesus* Gurjanova, 1936; *M. diversisexus* J. L. Barnard, 1967; *M. emarginatus*, J. L. Barnard, 1962; *M. glyconicus* J. L. Barnard, 1962; *M. latimanus* Boeck; *M. latissimanus* Stephensen, 1931; *M. mertensi* Gurjanova, 1951; *M. necopinus* J. L. Barnard, 1962; *M. packardi* Boeck, 1971; *M. perditus* J. L. Barnard, 1971; *M. recandesco* J. L. Barnard, 1967; *M. semenovi* Gurjanova, 1938; *M. sudor* J. L. Barnard, 1967. (17 species). **Southern hemisphere):** *M. abacus* J. L. Barnard, 1961; *M. antarcticus* K H. Barnard, 1932; *M. jazdzewskii* De Broyer, 1980; *M. scabriculosus* K. H. Barnard, 1932. (4 species).

The identity of the genus *Monoculodes*, and its type species, *Monoculodes demissus* Stimpson. Stimpson's original diagnoses of the genus *Mon-oculodes* and type species *M. demissus* are generalized, with few diagnostic features included. The text is unaccompanied by illustrations. Of the mouthparts, brief reference is made the mandibular palp and, in somewhat more detail to the maxilliped. Stimpson did not ascertain sexual dimorphism, although his comments on relative lengths of the antennae suggest that his specimens were probably mature females and/or larger immatures. Topotypes or other local species have not been identified subsequently. Stimpson's character states are therefore difficult, but not impossible, to apply to modern diagnoses of species and/or species groups within the *Monoculodes* group of oedicerotids. The diagnoses are repeated here, verbatim from the original text:

"Body tumid anteriorly, with the eyes so close together as to appear one. Superior antennae without accessory flagellum; inferior ones subpediform. Legs of the first two pairs with large subcheliform hands, formed of the last two articles of each; the antepenultimate joints having their inferior apices produced into slender thumbs. Legs of the

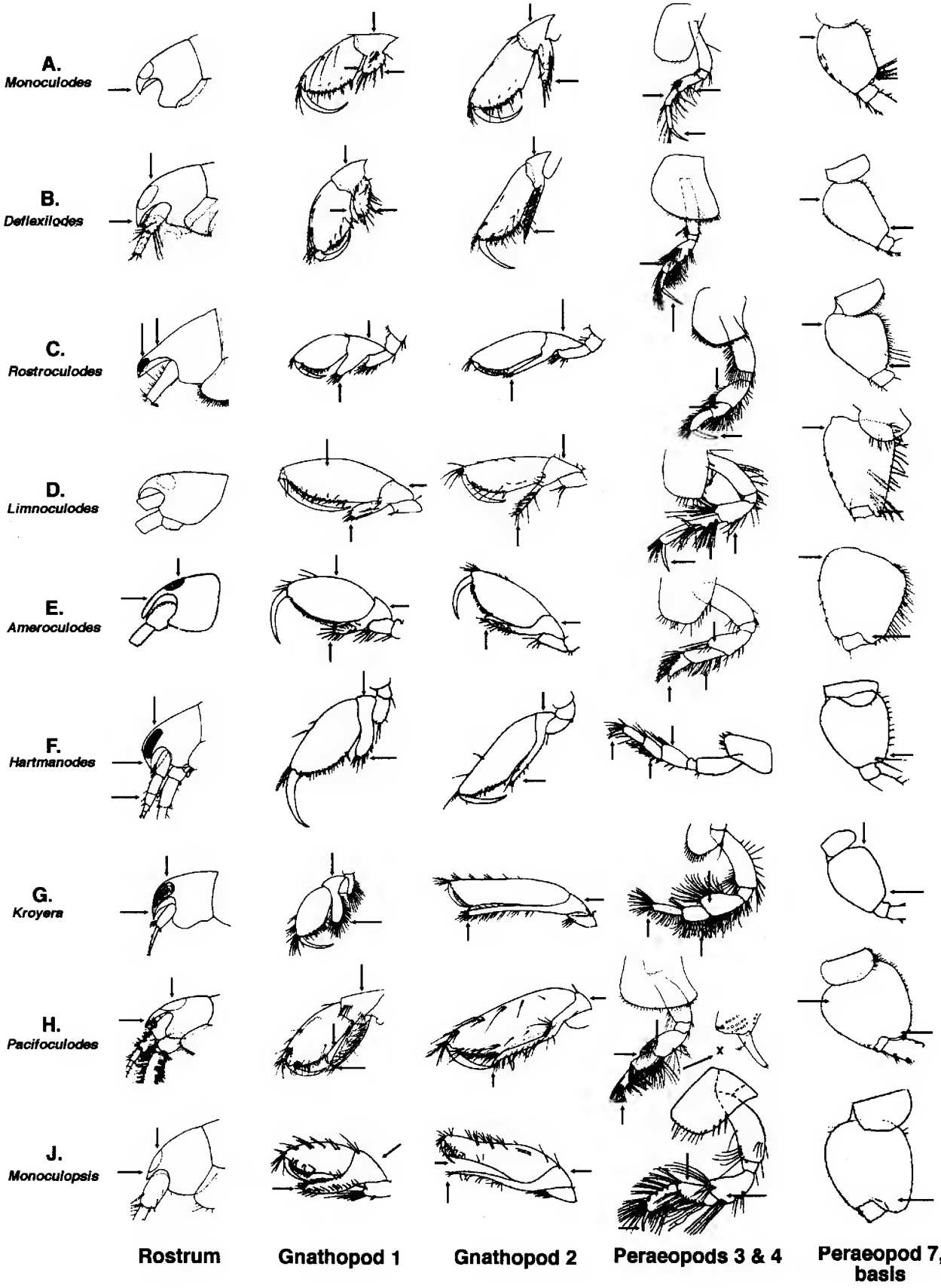

FIG. 1. GENERA OF THE *MONOCULODES* COMPLEX AND PRINCIPAL CHARACTER STATES

KEY TO GENERIC GROUPS WITHIN THE *MONOCULODES* SUPER GENUS

1. Gnathopods 1 & 2 propods short, broad, subsimilar, spine(s) at postero-distal angle long, slender; gnathopod 1, carpal lobe short, little or not exceeding mid point of propod; gnathopod 2, carpal lobe short, often less than half propod. . . . . *Monoculodes* Stimpson (p. 81)

—Gnathopods 1 & 2, propods medium to elongate, generally dissimilar in size and form, postero-distal angle with short spine(s); gnathopod 1, carpal lobe large, extending more than half length of propod; gnathopod 2, carpal lobe elongate, length exceeding half posterior margin of propod . . . . 2.

2. Gnathopod 1, carpus large, length >depth; carpal lobe short, not reaching postero-distal angle; gnathopod 2 carpal lobe not reaching beyond postero-distal angle . . . . 3.

—Gnathopod 1, carpus short, anterior margin narrow, length less than depth; gnathopod 2, carpal lobe elongate, tip exceeding postero-distal angle of propod . . . . 6.

3. Peraeopod 7, basis, postero-distal lobe very small or lacking; peraeopods 3 & 4, segment 5 <segment 6; coxa 4 regular, not broader than deep, little produced posteriorly; uropod 3, rami subequal . . . . 4.

—Peraeopod 7, basis, postero-distal lobe distinct, extending variously onto ischium; peraeopods 3 & 4, segment 5 <segment 6; coxa 4, very large, acutely produced behind; uropod 3, rami unequal . . . . 5.

4. Rostrum elongate, apex deflexed, perpendicular, eye fully (usually distally) upon it; peraeopods 3 & 4, segment 4 strongly broadened and setose antero-distally; peraeopods 5 & 6 distinctly unequal in form and size; maxilla 1, outer plate with 7 apical spines . . . . *Rostroculodes*, n. g. (p. 91)

—Rostrum regular, apex acute, eye usually basal; peraeopods 3 & 4, segment 4 slightly broadened and moderately setose distally; peraeopods 5 & 6, subequal in form and size (6 slightly larger); maxilla 1, outer plate with 9 apical spines . . . . *Deflexilodes* n. g. (p. 97)

5. Gnathopod 1, propod larger than in gnathopod 2; peraeopods 3 & 4, dactyls medium, little shorter than segment 6; antenna 1, peduncular segment 3 short, < 13. segment 2 . . . . *Limnoculodes* n. g. (p.115)

—Gnathopod 1, propod not large than propod of gnathopod 2; peraeopods 3 7 4, dactyls minute; antenna 1, peduncular segment 3 about half length of segment 2 . . . . *Ameroculodes*, n. g. (p. 93)

6. Peraeopod 7, basis, postero-distal lobe large, usually extending below ischium; coxa 5 very large, depth nearly equal to coxa 4. . . . . 7.

—Peraeopods 7, basis postero-distal lobe very small, shallow, or lacking; coxa 5 regular, depth distinctly less than coxa 4. . . . . 8.

7. Antenna 1, peduncular segment 3 elongate, length = segment 2; pleon plate 3, hind corner rounded; uropod 3, rami subequal in length . . . . *Monoculopsis* Sars (p. 115)

—Antenna 1, peduncular segment 3 short, <1/3 segment 2; pleon plate 3, hind corner obtuse, squared or variously produced; uropod 3, rami unequal . . . . *Pacifoculodes* n. g. (p. 102)

8. Pleon segments weakly mid-dorsally carinate; antenna 1 (female) extending beyond peduncle of antenna 2; peraeopods 3 & 4, segment 5 <<6 . . . . *Kroyera* Bate (p. 94)

—Pleon segments dorsally smooth; antenna 1 (female) shorter than peduncle of antenna 2; peraeopods 3 & 4, segment 5 >>segment 6 . . . . *Hartmanodes*, n. g. (p. 92)

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posterior five pairs unguiculate (dactylate), those of the last pair being exceeding long. Caudal stylets all biramous; the rami being equal. Maxilliped large, elongate, with unguiform terminal articles, and internal lamellae of about one-half their length. Mandible palpigerous.

The genus resembles *Eusirus* in the structure of the hands, and *Oediceros* in its long posterior feet. "

Stimpson's diagnosis of the type species, *M. demissus*, contains character states of mostly generic (or higher level) significance), quoted as follows.

"Body smooth and shining, broad and thick anteriorly, and slender posteriorly; the abdomen constituting more than three-sevenths of the total length. Epimera of the first five pairs of considerable size; the rest very small. Head tumid, terminating anteriorly in a large subtriangular rostrum, curving downward; at the base of which above are the large vermilion-colored eyes, which are so near together as to appear one, even when viewed from above. Antennae thick-based and about equal in length, reaching the fourth thoracic segment; the superior ones with a much longer flagellum than the subpediform inferior ones. Legs of the first two pairs with large oval hands, strong fingers, and thumbs formed from

prolongations from the antepenult joints, which are largest in the second pair. The remaining legs are simply unguiculate, the fifth and sixth pairs being very short, and the seventh of great length. Caudal stylets nearly smooth, of considerable length, tapering to fine points; the first pair reaching the extremities of the third. Colour wine yellow. Length, 0.35 inch (9.0 mm). Dredged in four fathoms, on a coarse sand and nullipore bottom, off Duck Island boat-moorings."

Allowing for some inaccuracy or distortion in his statements, Stimpson's combined diagnoses are undoubtedly those of an oedicerotid and a monoculodid, as its definition has been understood for the past 100 years (fide Sars, 1895; Stebbing, 1906). Unfortunately, his type material was apparently lost in the Chicago fire of 1871 (Manning et al, 1980?). Subsequent collections of amphipod crustaceans from that general region of the Bay of Fundy include those of the Biological Board of Canada (RV "Prince", 1913) which, though deposited in the CMN (Ottawa), have not yet been worked up and/or published upon.

Since *M. demissus* has not been identified in later literature, Stimpson's original species may prove synonymous with a subsequently described regional species. It is almost certainly a member of one of the generic groups encompassing known regional species. Watling (1981) combined earlier oedicerotid records mainly of Shoemaker (1930), Brunel (1970), and Bousfield (1973) to list 16 regional species of the *Monoculodes* group, as follows (major references in parentheses):

M. latimanus (Goes, 1966) (Shoemaker, 1930); *M. packardi* Boeck, 1871 (Shoemaker, 1930); *M. simplex* Hansen, 1887 (Gurjanova, 1951); *M. edwardsi* Holmes, 1905 (Shoemaker, 1930); *Monoculodes sp.* (=*M. edwardsi* Holmes cf. Bousfield, 1973, fide Barnard & Karaman, 1991); *M. borealis* Boeck, 1971 (Shoemaker, 1930); *M. schneideri* Sars 1895 (Shoemaker, 1930); *M. longirostris* (Goes, 1866); (Shoemaker 1930); *M. tenuirostratus* Boeck, 1871 (Shoemaker, 1930); *M. norvegicus* (Boeck, 1871) (Shoemaker, 1930); *M. tesselatus* Schneider, 1884 (Shoemaker, 1930); *M. tuberculatus* Boeck, 1871 (Shoemaker, 1930); *M. intermedius* Shoemaker, 1930 (Bousfield, 1973); and *Monoculopsis longicornis* Sars, 1895 (Shoemaker, 1930). Watling (loc. cit.) also listed *M. kroyeri* Sars, 1895, and *M. simplex* Hansen, 1887, as eastern North American marine faunal components but these have actually not been recorded closer to the Bay of Fundy (type locality of *M. demissus*) than the coast of Greenland.

Nearly all species (above) are inconsistent with Stimpson's generic and species diagnoses, based on what were very probably female specimens (above). Thus:
(1) Members of the *edwardsi* group of species have subequal antennae and deep coxal plates 1-5, but are now members of the genus *Ameroculodes* (p. 93). These are characterized by minute peraeopod dactyls (not "legs . .simply unguiculate") and by unequal, rather spinose, rami of uropods 1 & 2 that exceed the unequal rami of uropod 3 (not .." caudal stylets equal . . and nearly smooth, reaching the extremities of the third", as stated by Stimpson (loc. cit).
(2) members of the *longirostris* group, including *M. longirostris, M. kroyeri, M. schneideri*, and *M. borealis* are now members of genus *Rostroculodes* (p. 91). These are characterized by a strong, apically blunt rostrum that bears the eyes distally (not "eyes . . at the base of (the rostrum)" and coxal plates 1-5 are relatively small, rather than "of considerable size, the rest very small" of Stimpson (loc. cit.). Moreover, their gnathopod propods are small and unlike.
(3) Members of the *intermedius* group, containing *M. intermedius, M. norvegicus, M. tesselatus, M. tenuirostris*, and *M. tuberculatus* are now placed in the genus *Deflexilodes* (p. 97). These do tend to have relatively large coxa plates 1-5 and conspicuous dactyls on all the peraeopods, but the gnathopod propods are usually small, and/or dissimilar in size and form, and the carpal lobe of gnathopod 2 tends to be variously elongate and lying close to the propod, rather than projecting "thumb like" and "like *Eusirus*" (of Stimpson, above).
(4) In *Monoculopsis longicornis*, antenna 1 is longer than antenna 2, and the anterior coxae are large, but the rostrum is very short, the gnathopods small and very dissimilar, and the peraeopod dactyls are short.

The remaining species, *M. latimanus* and, to lesser extent, *M. packardi*, conform generally best with Stimpson's characters states of eyes, rostrum, antenna, gnathopods, peraeopod dactyls, uropod rami, and body length (~9 mm). These two species have also been recorded fairly commonly in nearby Gulf of St. Lawrence, at depths of 30-93 m., and *M. latimanus* is known elsewhere in depths as shallow as 4 m. (Shoemaker, 1930). The two species exhibit mainly plesiomorphic character states (Fig. 40, Table I) and are here selected as representative, in detail, of the genus *Monoculodes* based on *M. demissus* Stimpson, 1853.

Formal rediagnosis of *Monoculodes* Stimpson. Body smooth above. Rostrum short to medium, normal, eye basal, seldom fully on rostrum; anterior head lobe rounded. Antennae sexually dimorphic; short, weakly setose in female. Antenna 1, peduncular segment 2 medium, 3 medium; flagellum little exceeding peduncle of antenna 2, callynophorate in male. Antenna 2, peduncular segments 4 & 5 subequal; flagellum elongate in male.

Mouthparts not described but probably similar to those of *N. necopinus* and *N. castalskii*): Lower lip, inner lobes separate. Mandible, molar strongly triturative; left lacinia 5-dentate, right lacinia bifid; blades 4-7; incisor toothed; palp slender, segment 3 not longer than 2, with posterior marginal D-setae. Maxilla 1, outer plate typically with 9 apical spines; palp slender. Maxilla 2, plates regular. Maxilliped, inner plate with apical spine(s) and setae; outer plate tall, inner margin masticatory; palp slender, segment 2 little (or not) broadened.

Coxal plates 1-4 medium deep. Coxa 1 distally broadened; coxae 2 narrow to medium, weakly or not spinose behind. Gnathopods 1 & 2 not sexually dimorphic; bases short; propods stout, subsimilar, palmar angle with single slender spine. Gnathopod 1, propod regular, short, broadening

distally, not deflexed, length 1-2 X depth; carpus longer than deep, hind lobe short, not reaching palmar angle.

Coxal plate 3 regular, larger than 2; coxa 4 regular, little broadened distally, lower margin convex. Peraeopods 3 & 4 , segments not strongly fossorial (setose); segment 5 < 6; dactyls medium to long, tips with chitinous ring. Coxa 5 medium, ~aequilobate. Coxa 6 regularly deep. Peraeopods 5 & 6 subsimilar in form, 6 slightly larger, segment 4 relatively long, not strongly expanded or setose; segment 5 shorter than 6; dactyls strong, >segment 6, tips usually with strong chitinous rings. Peraeopod 7, basis regular, not broadly expanded proximally, postero-distal lobe small, shallow.

Pleon plates 2 & 3, hind corners broadly obtuse or rounded. Uropods 1, 2, & 3, rami subequal, weakly spinose, tips extending subequally rearward. Telson short, apex truncate, shallowly rounded or weakly emarginate, apical margin with 2 unequal pairs of short spines and/or setae.

Coxal gills regular. Brood plate with strongly setose marginally and apically.

Distributional ecology: Members of the genus are subtidal to bathyal in coastal waters of the North Pacific, Arctic, North Atlantic, and a few are antiboreal, in deep water.

Taxonomic commentary: This large group is morphologically diverse and may lends itself to further subdivision at subgeneric, if not full generic level. Thus the *M. catalskii* group with short, *Bathymedon*-like rostrum, and bulging hind lobe of peraeopod 7 basisis distinctive. Species of the southern hemisphere (e.g., *M. abacus* and *M. jazdzewskii* are appear different in gnathopods and mouthparts (e.g., maxilla 1 with 7 outer plate spines in some species. Further analysis, without examining material , is beyond the scope of this study.

Monoculodes latimanus (Goes)
(Fig. 2)

Oediceros latimanus Goes, 1866: 527, fig. 23.
Monoculodes latimanus (Goes) Sars, 1895: 298, pl. 106, fig. 2.—Stebbing, 1906: 264.—Gurjanova, 1951: 583, fig. 390.—Shoemaker, 1955: 37.—Barnard, 1967: 77—Barnard & Karaman, 1991: 560.

Material Examined: 15 specimens in 10 lots, from southeastern Alaska to southern Vancouver Island.
ALASKA:
Southeastern Alaska, ELB Stn. S13F1, Off Sister Lake, gravel & algae, 3 m., July 31, 1980 - 1 immture specimen

BRITISH COLUMBIA:
North-central coast, ELB Stn. H36 (Safety Cove, Calvert I.), gravel, shells, 30-85 m. - female, br. II. (9.0 mm), **fig'd specimen,** CMN cat. no. NMCC0990-1169 + 1 other female.
Swanson Bay, C. R. Levings Stns., 1975: - 7 specimens, in 5 samplings, postly penultimate males; Stn M#3 - male penultimate (9.0 mm), **fig'd specimen,** CMN cat. no. NMCC-1990-463.
Vancouver Island, south end. ELB Stn. P24 (Koskima Bay), 20-30 m., mud, silt, woody detritus, Aug. 14, 1975 - 1 immature specimen.

G. O'Connell Stns., Victoria, August, 1976: off Clover Pt. - 3 specimens; off McCauley Pt. - 1 immature specimen.

Diagnosis. Female br. II stage (9.0 mm). Rostrum short, deflexed. Eyes partly on base of rostrum. Anterior head lobe relatively narrow, upper corner subacute. Antenna 1longer than peduncle of antenna 2; peduncular segment short, setose; segment 3 > 1/2 segment 2; flagellum with 10+ segments. Antenna 2, peduncular segments stout, setose, segmeent 4 shorter than 5; flagellum of 50+ short segments.

Lower lip shallow, broad, inner lobes distinct. Mandible, left lacinia 5-dentate; spine row with 5-6 slender blades; incisor irregularly toothed; palp segment 3slender, shorter than segment 2. Maxilla 1, palp segment 2, outer margin convex, with 5 slender setae. Maxilla 2, inner plate broader than outer plate. Maxilliped, inner plate medium short, apex with tall spine and several setae; outer plate shorter, outer margin strongly convex; palp segment 2 somewhat broadened (distorted in slide mount).

Coxae 1-4 subequally deep, lower margins very strongly setose. Coxa 4 slightly produced behind. Gnathopod 1, basis with antero-distal cluster of longish setae; meral process very short; carpal lobe stout, very short; propod short strongly braodening distally, palm oblique, convex. Gnathopod 2, basis with weak antero-distal setal cluster; carpal lobe extending about 1/2 length of posterior margin of propod; propod subovate, length~2X depth; palm strongly oblique.

.Peraeopods 3 & 4 fossorial, segment 4 moderately expanded and setose distally; dactyls slender, not longer than segment 6. Coxa 5 broad, aequilobate. Peraeopod 6, basis larger than in peropod 5. Peraeopods 5 & 6, dactyls shorter than segment 6, chitinous rings vestigial. Peraeopod 7, basis broad, narrowing distally, hind margin slightly bowed, strongly setose; lower lobe small.

Pleon plates 2 obtusely rounded behind, margins nearly bare. Uropod 1, rami subequal, shorter than peduncle, margins with short spines. Uropod 2, outer ramus shorter. Uropod 3, rami subequal.

Telson short, broad, apical margin convex, armed with 4 slender setae. Coxal gills large, broadly sac-like, rounded distally. Brood plates partly developed, lacking marginal setae.

Male penultimate stage (9.0 mm): Antenna 1, peduncular segments 2 and 3 very short; flagellum ~17-segmented, extending beyond peduncle of antenna 2. Antenna 2, flagellum ~60-segmented, much exceeding peduncle.

Distributional ecology. *Monoculodes latimanus* is here recorded from southeastern Alaska to the southern end of Vancouver Island, on mud and shell bottoms, to depths of more than 60 m.

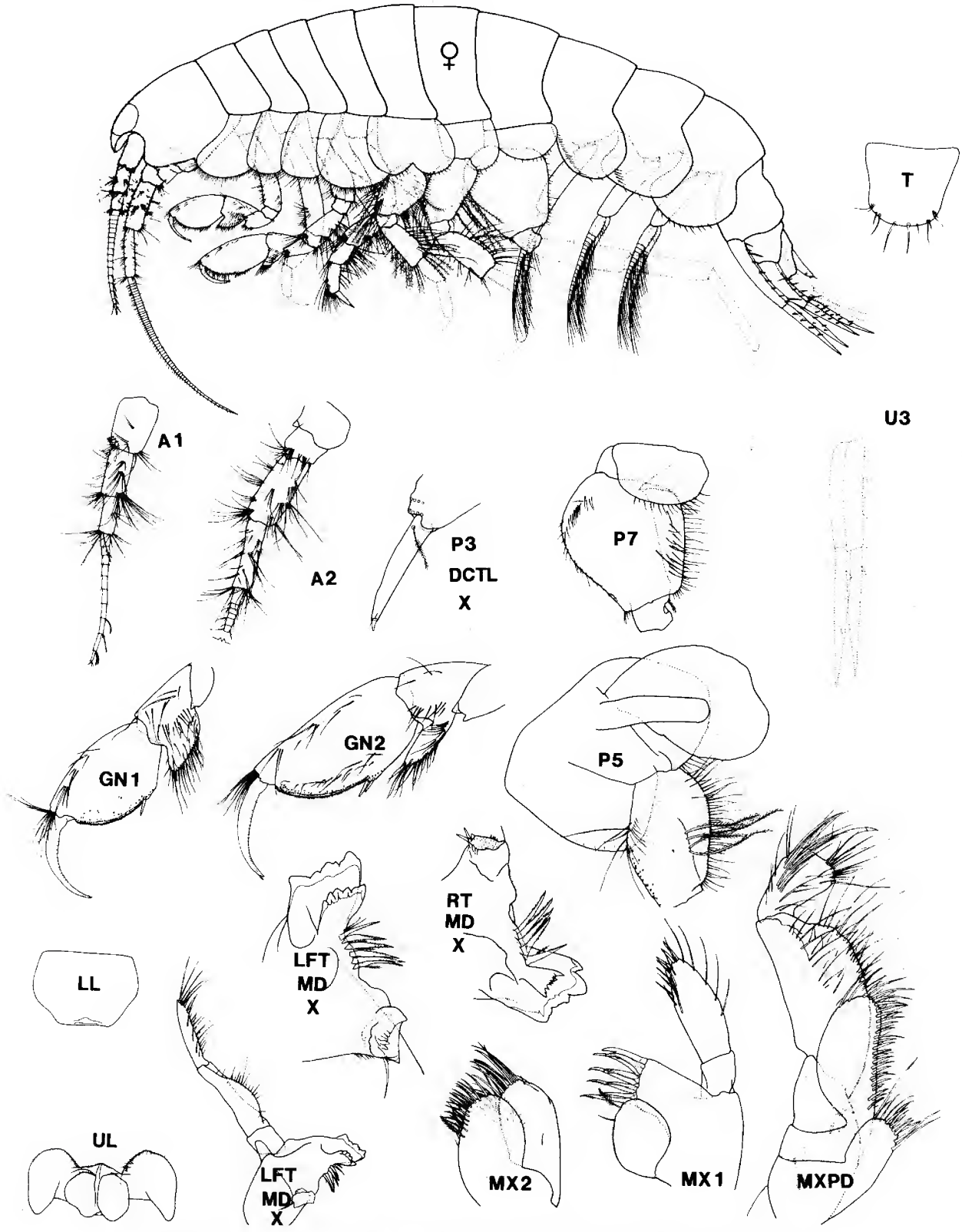

FIG. 2. *Monoculodes latimanus* Boeck. Safety Cove (H36), Calvert I., B. C. Female (9.0 mm); male (9.0 mm).

Taxonomic commentary. The present material appears very close to *M. latimanus* (Goes), as illustrated by Sars (loc. cit.). It differs from it in the relatively long peduncular segment 3 of antenna 1 (female), the more strongly setose apical margin of the telson, and a number of other relatively minor features. The incomplete nature of the present material, mostly lacking distal segments of the peraeopods, mitigates against recognizing such differences at formal species level.

KEY TO NORTH PACIFIC SPECIES OF *MONOCULODES* SENS. STR.*

1. Eyes pigmented; sublittoral and shelf species . . . . 2.
—Pigmented eyes lacking ; mostly bathyal species . . . . 11.

2. Rostrum very short, little or not exceeding anterior head lobe; peraeopods 3 & 4, segment 4 stout, distally strongly setose; peraeopod 7, basis with postero-distal bulge . . . . 3.
—Rostrum regular, apex distinctly exceeding anterior head lobe; peraeopods 3 & 4, segment 4 normal, not exceptionally tout or setose antero-distally; peraeopod 7, basis lacking lobe . . . . 4.

3. Gnathopod 1, propod large; antenna 1 shorter than antenna 2 . . . . *M. castalskii* Gurj. (p. 87)
—Gnathopod 1, propod regular; antenna 1 longer than antenna 2 . . . . *.M. brevirostris* , n. sp. (p. 89)

4. Telson, apex variously notched or indented . . . . 5.
—Telson, apical margin straight or slightly convex . . . . 6.

5. Gnathopod 2, propod short, deep; antenna 1, peduncle 2 >1 . . . . *M. emarginatus* J. L .Barnard (p. 85)
—Gnathopod 2, propod length ~1.5X depth; antenna 1, segment 2 <1 . . . . *latimanus* Boeck (p. 82)
6. Antenna 2, flagellum long, equal to, or longer than, peduncle . . . . 7.
—Antenna 2, flagellum shorter than peduncle. . . . . 10.

7. Rostrum medium, reaching 1/2 peduncular segment 1, antenna 1 . . . . *perditus* Barnard (p. 85)
—Rostrum regular, apex reaching nearly to end of peduncular segment 1, antenna 1 . . . . 8.

8. Gnathopod 1, carpal lobes short, weak; Pacific species . . . . *M. mertensi* Gurjanova
—Gnathopod 1, carpal lobes stout; Atlantic species . . . . 9.

9. Gnathopod 1, propod stout; uropods 1 & 2, rami long slender . . *M. demissus* Stimpson (TYPE, p. 78)
—Gnathopod 1, propod smaller than 2; uropods 1 & 2, rami shorter than peduncle . . *M. packardi* Boeck

10. Antenna 1, flagellum shor,t reaching ~end of peduncle of antenna 2; gnathopod 2, basis anterodistally setose . . . . *M. diamesis* Gurj. (p. 89)
—Antenna 1, flagellum long, exceeding peduncle antenna 2; gnathopod 2, basis weakly setose anterodistally . . . . *M. semenovi* Gurjanova.

11. Gnathopod 1, propod very broad distally, palm nearly vertical . . . . 12.
—Gnathopod 1, propod regular, length ~ 1.5X depth, palm oblique . . . . 13.

12. Rostrum very short; antenna 1, peduncular segment 2 <segment 1 . . . . *M. diversisexus* J. L. Barnard
—Rostrum exceeding anterior head lobe; peduncular segment 2 >> 1. . . . *M. latissimanus* Steph. (p. 87)

13. Rostrum short,not exceeding head lobe; telson, apical margin with median pair of short spines . . . 14.
—Rostrum normal, exceeding anterior head lobe; telson, apical margin with median pair of setae . . . . 15.

14. Gnathopods 1 & 2, carpal lobes short, < 1/2 propod; pleon plate 2 weakly setose . *M. recandesco* JLB
—Gnathopods 1 & 2, carpal lobes nearly reaching palm; pleon 2 strongly setose . . *M. necopinus* Barnard

15. Peraeopods 3 & 4, segment 6 setose behind; peraeopods 5 & 6, segment 6, posyterior margin strongly setose . . . . *M. sudor* J. L. Barnard
—Peraeopods 3 & 4, segment 6 lacking posterior marginal setae; peraeopods 5 & 6, segment 6, hind margin with a few setae only . . . . *M. glyconicus* J. L. Barnard

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* includes North Atlantic representative type species *M. demissus* Stimpson, and *M. packardi* Boeck but excludes western North Pacific species *M. dentimanus* Jo, 1990, *M. muwoni* Jo, 1990, and *M. koreanus* Jo, 1990.

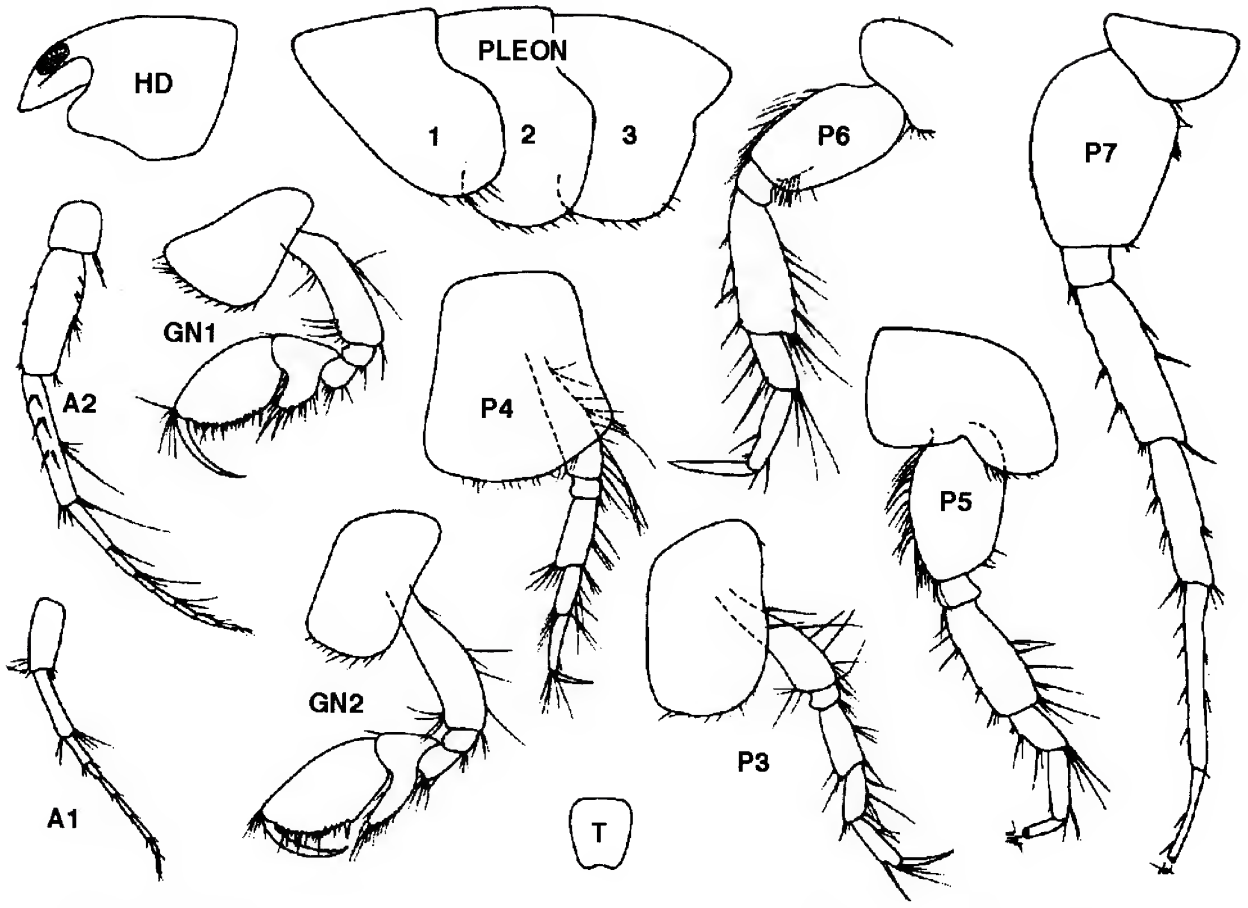

FiG. 3. *Monoculodes emarginatus* J. L. Barnard. Southern California. Female (4.5 mm). (after Barnard, 1962)

Monoculodes emarginatus J. L. Barnard
(Fig. 3)

J. L. Barnard, 1962e: 361, fig. 4.—Barnard, 1964: 234.—Barnard, 1966a: 76.—Barnard, 1966b:26—Barnard, 1971: 51.—Barnard & Karaman, 1991: 559.

Taxonomic commentary: The species was described and figured from material dredged off the coast of southern California in depths of 20-50 m. *Monoculodes emarginatus* differs fromthe co-occurring *M. latimanus* Boeck in its more elongate carpal lobe of gnathopod 2, the less broad basis of peraeopod 7, and the distinctly emarginate, weakly armed apical margin of the telson.

The species is very similar to *Monoculodes perditus* Barnard (see below). However, *M. emarginatus* differs in its emarginate telson, relatively straight rostrum (female), shorter dactyls of peraeopods 3 & 4, staighter hind margin of the basis of peraeopod 7, and less strongly rounded hind margin of pleon plate 3.

The mouthparts of *M. emarginatus* have not yet been described. Their detailed comparison with those of *M. perditus* awaits re-eaxamination of type material.

Distributional Ecology. From Oregon to Baja California, on fine mud, at depths of 55-200+ m.

Monoculodes perditus J. L. Barnard
(Fig. 4)

Monoculodes perditus J. L. Barnard, 1966: 77, fig. 30.—Barnard & Karaman, 1991: 560.

Material Examined. 86 specimens from 16 localities:
BRITISH COLUMBIA:
North-central mainland coast. ELB Stns., July, 1964: H21, H24 H36, H37 - 75 specimens.
C. Levings. Stns., Swanson Bay, 1975: M#1, M#3, M#5, JC - 7 males, females, immatures.
C. Levings Stns)-4a (Ocean Falls) - 1 specimen.
Vancouver Island, south end. ELB Stns., July, 1975: - P13; P24; P25; P24); P26 - 25 males, females, immatures.
ELB Stns., July, 1976, B21b (off Brady's Beach), sand algae, woody debris at 10-20 m. - Female (6.0 mm), male (6.0 mm), **fig'd specimens,** CMN cat. no. NMCC1990-483; also B24; B26; B27; B28 - 10 specimens.
ELB Stns., May, 1977: Stn P21a, 44 m., fine sand.
K E Conlan Stns., French Creek, 1977- 1 specimen.
G. O'Connell Stns., Aug., 1976: W7b, W153b - 4 specimens CMN collections, Ottawa.

Diagnosis. Female subad. (6.0 mm). Rostrum medium strong, deflexed. Eyes basal on rostrum. Anterior head lobe

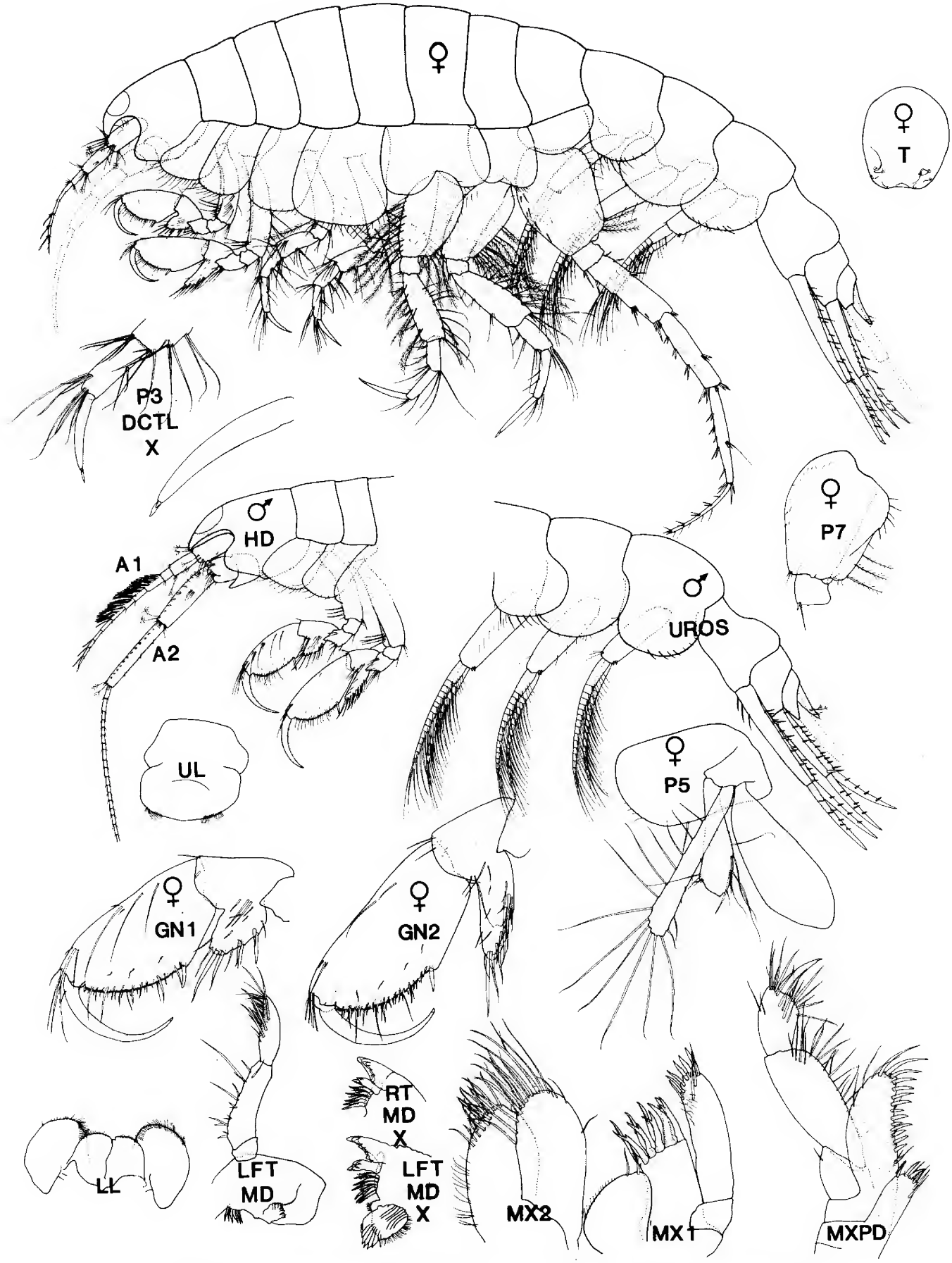

FIG. 4. ***Monoculodes perditus*** **J. L. Barnard. Off Brady's Beach (B21b), B. C.. Female (6.0 mm); male (6.0 mm)**

bluntly rounded. Antenna 1 slightly longer than peduncle of antenna 2; peduncular segment 2 short, setose; segment 3 ~ 1/2 segment 2; flagellum with 6-7 segments. Antenna 2, peduncular segments stout, setose, segment 4 slightly shorter than 5; flagellum and peduncle subequal in length.

Lower lip shallow, broad, outer lobes large. Mandible, left lacinia 5-dentate; spine row with 5-6 slender blades; incisor irregularly toothed; palp relatively short, stout, segment 3 shorter than segment 2. Maxilla 1, palp slender, outer margin lacking setae. Maxilla 2, plates subequal in width. Maxilliped, inner plate strong, apex with 3 tall spines and several slender setae; outer plate medium tall, outer margin convex, with a few distal setae; palp segment 2 slender, segment 3 and dactyl relatively short.

Coxae 1-4 broad, increasing in depth posteriorly, lower margins moderately setose. Coxa 4 broad, not produced behind. Gnathopod 1, basis with small antero-distal cluster of longish setae; meral process short; carpal lobe stout, short; propod medium, palm oblique, longer than hind margin. Gnathopod 2, basis with weak antero-distal setal cluster; carpal lobe extending 2/3 length of posterior margin of propod; propod broadening distally, length >2X depth; palm and posterior margin subequal in length.

Peraeopods 3 & 4 weakly fossorial, segment 4 little expanded or setose distally; dactyls slender, longer than segment 6, tips with minute chitinous rings. Coxa 5 broad, relatively shallow, aequilobate. Peraeopods 5 & 6 closely subequal; segment 4 little broadened; dactyls slender, longer than nearly bare segment 6. Peraeopod 7, basis little broadened, hind margin indented, lower lobe small.

Pleon plate 2 brodly rounded behind, margin nearly bare. Uropods 1 & 2, rami short, subequal. Uropod 3 not present.

Telson short, broad, outer margins convex; apical margin shallowly incised, very weakly armed. Coxal gills elongate, saclike, distally subacute. Brood plates slender, strap-like, margins sparsely long-setose.

Male (5.5 mm): Rostrum less strongly deflexed. Antenna 1, proximal flagellar segments callynophorate but not conjoint. Antenna 2, peduncular segments 4 & 5 elongate, anterior margin with fine brush setae; flagellum elongate.

Distributional ecology. In subtidal shelf waters, on sandy silt, in depths of 20-200 m., from northern British Columbia, through Oregon to southern California.

Taxonomic commentary. Except for its larger size, the material from British Columbia compares in detail with the small (2.9 mm) male (?) specimens of *M. perditus* taken at depths of 180 m. off southern California and figured by Barnard (loc. cit). In the larger B. C. material (fig.) the propods of gnathopods 1 & 2 are larger and more elongate, and the coxal plates, esp. coxa 4, are broader, than in the small Californian specimens. Barnard (loc. cit.) further distinguished this species from similar and related species of the North Pacific region such as *M. coecus* Gurj. 1951, *M. diamesus* Gurj., and *M. latimanus* (Goes), here supported by the phenogram of species of *Monoculodes* (Fig. 40, p. 140).

Monoculodes latissimanus Stephensen
(Fig. 5)

Monoculodes latissimanus Stephensen, 1931: 244, fig. 70.—Gurjanova, 1951: 585, fig. 392.—Barnard, 1966: 76, fig. 29.—Barnard 1967: 113, figs 521-c.—Barnard & Karaman, 1991: 560.

Taxonomic and distributional commentary. Barnard (loc. cit.) has recorded the species at bathyal depths from off the coast of Oregon and California. It probably occurs also off the coast of british Columbia, but none was taken in study material. The species ranges elsewhere from Greenland ro Davis Strait, at depths to 1096 m. It also ranges southwards along the North American Atlantic coast in high latitudes, at least to the Gulf of St. Lawrence (Shoemaker, 1930) and probably also the Bay of Fundy (Watling, 1979).

The species is suyperfically similar to the following eyeless species, *M. brevisotris*, n. sp., but is distinguished by its longer rostrum, shorter antenna 1, and shorter broader gnathopod propods.

Monoculodes castalskii (Gurjanova)
(Fig. 6)

Monoculodes castalskii Gurjanova, 1951: 572 , fig. 377.—Barnard, 1967: 358 (key).—Barnard & Karaman, 1991: 559.

Material Examined.
ALASKA:
Aleutian Islands. Unimak I., P. Slattery Stns., 1982: C77 - 2 female subadult speciemens (10.0 mm); C79 - 3 immature specimens (to 5.0 mm); C127 - 1 immature. CMN collections, Ottawa. .

Taxonomic and distributional commentary. Gurjanova's original description and figures of 12 mm female specimens of *Monoculodes castalski* do not treat the mouthparts. However, in present specimens, the mouthparts appear similar overall to those of *M. brevirostris* (fig.). Antenna 1 is described as slightly shorter than antenna 2. The chitinous rings of the tips of the dactyls, especially of peraeopods 5 & 6, are relatively large. The postero-distally bulging hind lobe of the basis of peraeopod 7 appears typical of this group of species

Distributional Commentary. *Monoculodes castalskii* has been recorded from the Sea of Japan Sea and the Kara Sea at depths of 80-290 m. On the North American Pacific coast the species has not been recorded south of the Aleutian Chain.

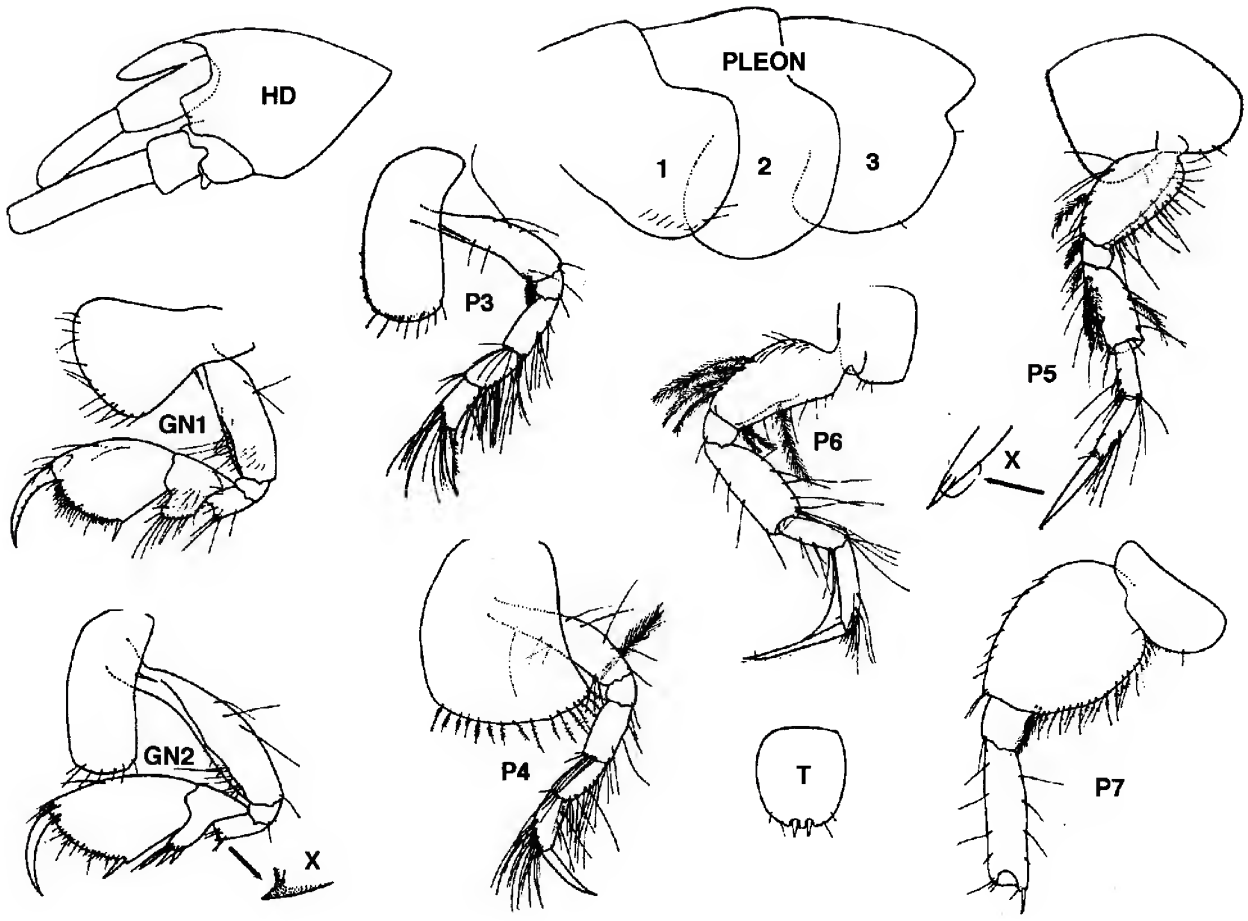

FIG. 5. ***Monoculodes latissimanus*** **Stephensen, 1931. Off Southern California. Female (3.0 mm). (After Barnard, 1966).**

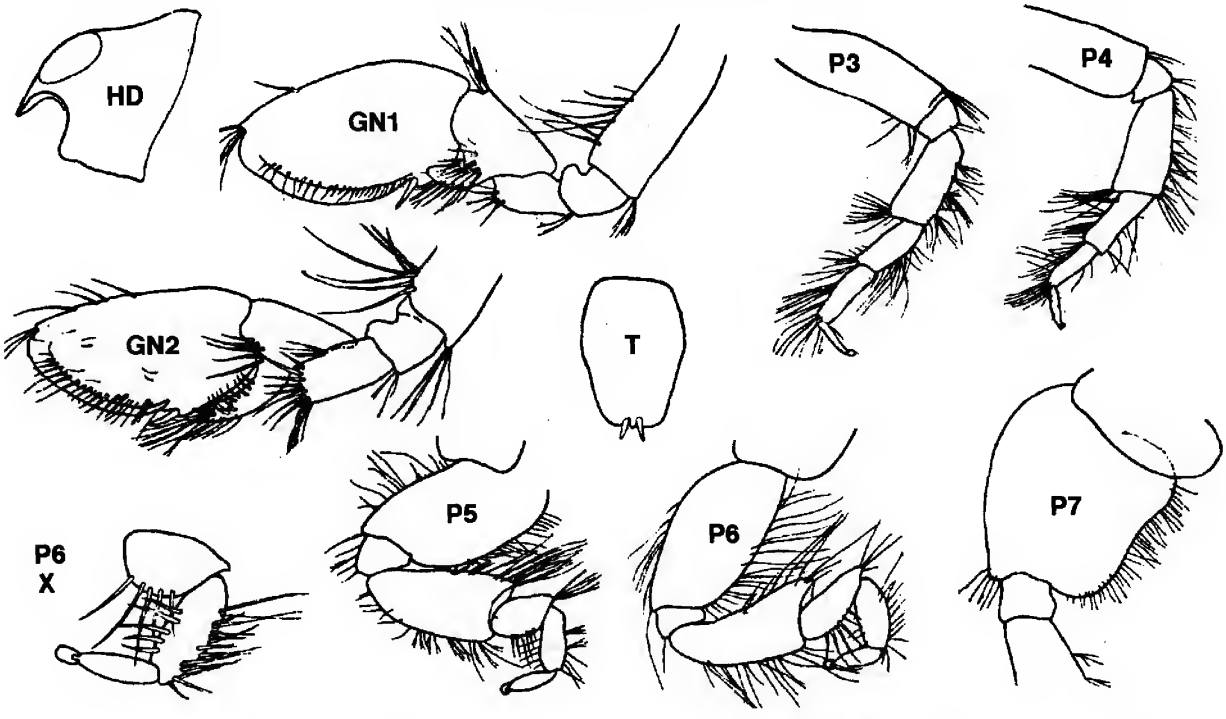

FIG. 6. ***Monoculodes castalskii*** **Gurjanova. Kamchatka & Bering Sea regions. Female (12.0 mm).**

Monoculodes brevirostris, new species
(Fig. 7)

Material examined:
BRITISH COLUMBIA:
South-central mainland coast. ELB Stns. P1-P8, (Burrard Inlet & vicity), fine mud and woody detritus, at depths of 44-240 m, Nov. 2-4, 1977. About 80 specimens, nearly all subadult, at 8 dredge stations including:
Stn. P7, Queen Charlotte Channel, south of Bowen Island, 240 m., mud and woody detritus, in association with a rich amphipod and decapod fauna - 1 female ov (11.0 mm), **Holotype**, CMN Cat. No. NMCC-1991-0409.
ELB Stn. E5 (Indian Arm, south channel), mud, coarse dand at 60 m., Nov. 4, 1977 - 1 female.
CMN collections, Ottawa.

Diagnosis. Female ov (11.0 mm): Rostrum very short, *Bathymedon*-like. Eyes weakly pigmented, barely impinging on base of rostrum. Anterior head lobe relatively narrow, upper corner subacute. Antenna 1 <antenna 2; flagellum of 40+ medium segments. Antenna 2, peduncular segments 4 & 5 subequal in length; flagellum of 25+ short segments.

Mandible, left lacinia 6-dentate; spine row with 4-5 slender blades; palp segment 3 medium, slender, inner margin with elongate "D" setae. Maxilla 1, palp stout apex broad, oblique. Maxilliped, outer plate tall, slender; palp segment 2 slightly broadened, inner distal margin oblique.

Gnathopod 1, basis, with antero-distal cluster of short setae; carpal lobe stout, propod little longer than carpus, hind margin nearly straight, about equal in length to palm. Gnathopod 2, basis with weak antero-distal setal cluster; carpal lobe narrowing sharply extending about 1/2 length of posterior margin of propod that is longer than the palmar margin.

Coxa 3 relatively broad, lower margin shallowly incised. Coxa 4 nearly as broad as deep, hind corner acute. Peraeopods 3 & 4, dactyls not longer than segment 6, chitinous rings minute. Coxa 5, weakly postero-lobate. Peraeopods 5 & 6, dactyls ~equal in length to segment 6. Peraeopod 7, basis narrowing distally, hind margin normally setose, lower hind lobe shallow, broadly rounding; posteromedially with 2-3 long plumose setae..

Pleon plates 2 & 3, broadly rounded behind. Uropods 1 & 2 rami shorter than peduncle, margins each with 2-4 short spines. Uropod 3, rami longer than peduncle , margins 4-5 spinose., telson subrectangular, apical margin with 2 short spines and 2 short setae at the corners.

Etymology. From the Latin "brevis" - short, and "rostrum" -frontal process, with reference to the very short rostrum.

Distributional ecology. Known only from medium deep muddy sediments in Burrard Inlet; probably occurring in other fiords northward along the mainland coast of British Columbia.

Taxonomic commentary. *Monoculodes brevirostris* is very similar to *A. castalski* Gurjanova that has been recorded from Bering Strait to the Sea of Japan (Gurjanova, 1951). In the latter species, however, the rostrum is longer, the propod of gnathopod 1 much stronger, segments 5 & 6 of peraeopods 5 & 6 are more strongly spinose, the telson is broadest medially, and its paired apical marginal spines are much stouter and closer together.

Monoculodes diamesus Gurjanova
(Fig. 8)

Monoculodes diamesus Gurjanova, 1936: 564, fig. 372.—Gurjanova, 1951: 565, fig. 372.—Barnard & Karaman, 1991:

Material Examined: Eight specimens in two lots.
BRITISH COLUMBIA:
South-central mainland coast. ELB Stns., Jervis Inlet, May 12, 1977: Stn. J1 (off Queen's Beach), ooze and woody detritus, 360 m - 2 immature females; Stn. J2 (off Princess Royal Beach), mud, woody detritus, 576 m. - 2 immature females (to 4.5 mm) + 2 smaller specimens. CMN collections, Ottawa.

Diagnosis. Gurjanova (loc. cit.) partly described and figured mature female material (length to 12.0 mm). The rostrum is relatively long and nearly straight, and the anterior head lobe slightly upturned. The gnathopod propods are relatively slender, the carpal lobes very short. Peraeopods 3 & 4 are moderately fossorial, with distal segments setose, the dactyls large and thick. The hind margin of the telson is subtruncate and finely setose.

Present material from British Columbia is small, very immature, and was not examined in detail or illustrated.

Distributional ecology. Previously known only from the Chukchi Sea, at depths of 20-40 m. Here recorded from bathyal depths of a south-central mainland fiord of British Columbia having a shallow sill at its entrance.

Monoculodes packardi Boeck

Monoculodes packardi Boeck, 1871 per Gurjanova, 1951: 581. fig. 388.—Barnard & Karaman, 1991: 560.

Taxonomic and Distributional commentary. This species is dominant in coastal shelf waters of the North Atlantic, but in the North Pacific has been recorded only by Gurjanova (loc. cit.) from the Sea of Japan.

This eyed sublittoral species is most closely similar to the advanced group of eyeless bathyal species described by J. L. Barnard from submarine canyons off the coast of California. These include *M. necopinius, M. glyconicus,* and *M. sudor*, as listed above (p. 78) and keyed (p. 84). None was found in present material.

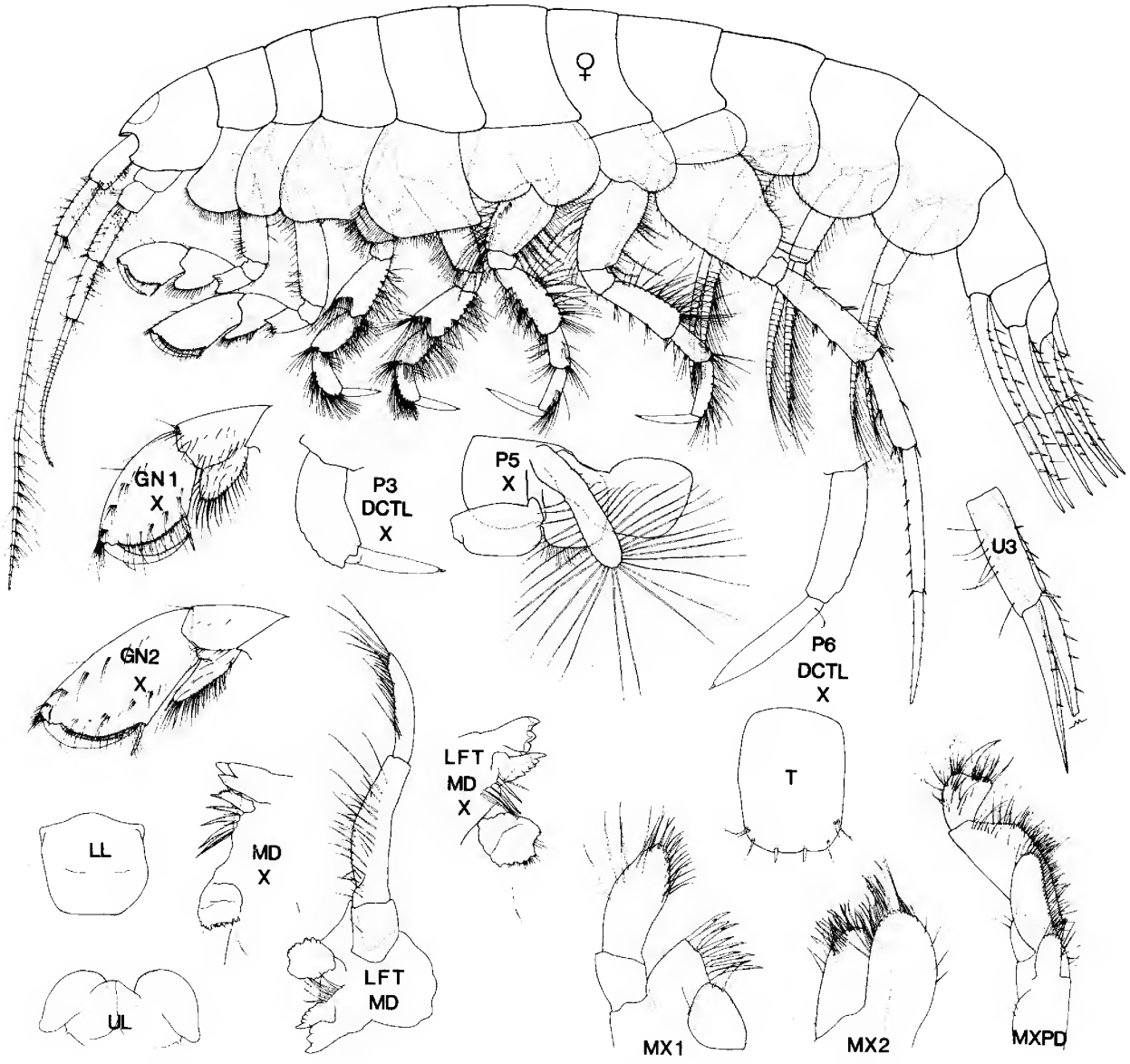

FIG. 7. ***Monoculodes brevirostris,*** **new species. Off Bowen Island, B. C. Female (11.0 mm).**

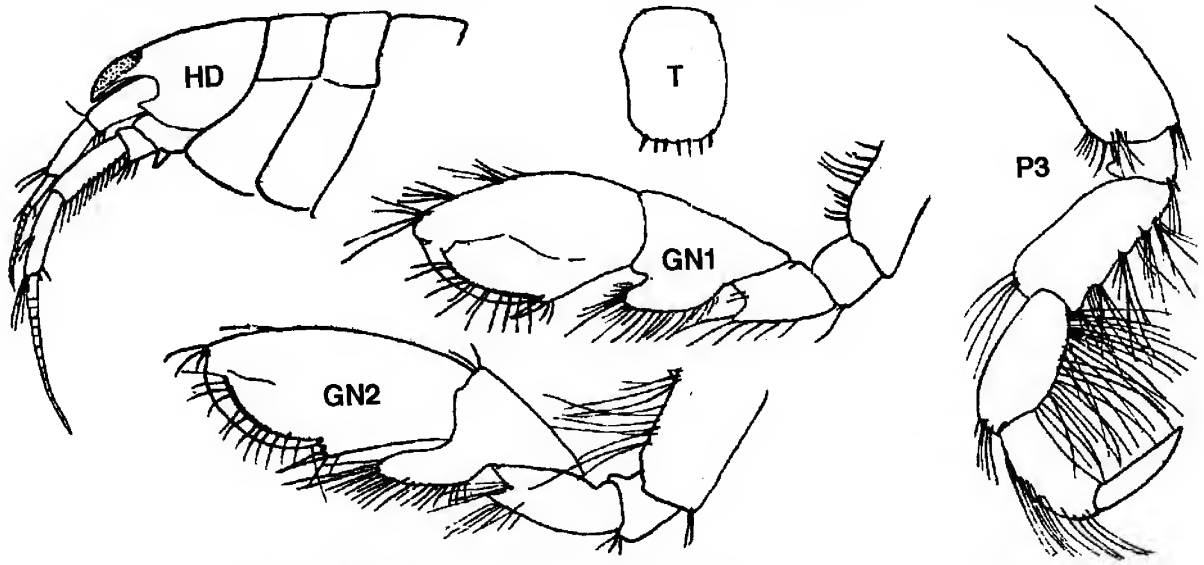

FIG. 8. ***Monoculodes diamesus*** **Gurjanova. Chukchi Sea. Female (12.0 mm) (after Gurjanova, 1951).**

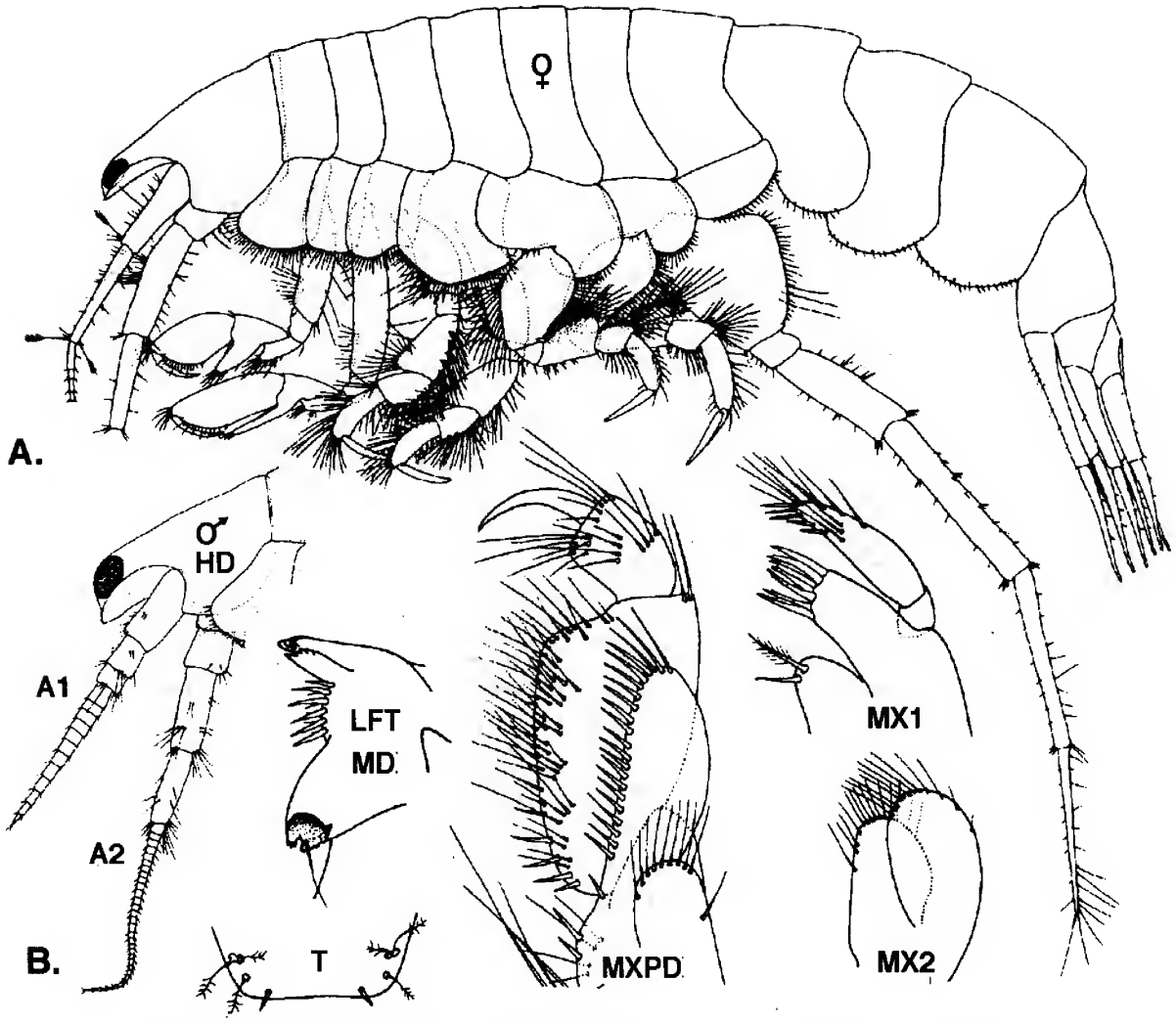

FIG. 9. *Rostroculodes* species. Off Northeast Greenland. (after Just, 1980).
A. *Rostroculodes longirostris* (Goes). Female subadult (12.9 mm).
B. *Rostroculodes vibei* (Just). Male (10.6 mm), mouthparts, telson apex..

Rostroculodes, new genus

Monoculodes Stimpson (part) Sars, 1895: 294.—Stebbing, 1906: 258. Gurjanova, 1951: 562.—Shoemaker, 1955:—Lincoln, 1979: 348.—Barnard & Karaman, 1991: 559.
Monoculodes longirostris group Just, 1980: 30.

Type species. *Monoculodes longirostris* (Goes, 1865), present designation.

Species. *Rostroculodes hanseni* (Stebbing 1894); *R. kroyeri* (Sars, 1895); *R. schneideri* (Sars, 1895); *R. borealis* (Boeck, 1871); *R. vibei* (Just, 1980).

Diagnosis. Peraeon and pleon segments 2 & 3 smooth or weakly carinate mid-dorsally. Rostrum elongate,straight or slightly deflexed and bearing eyes apically or subapically. Antenna 1, peduncle slender, segment 2 distinctly longer than 1, segment 3 very short; flagellum weakly callynophorate in male. Antenna 2, flagellum elongate in male.

Mouthparts (based on *R. vibei* Just): molar slender, apex small, weakly triturative, rimmed by cutting teeth; spine row with slender blades; left lacinia 5-dentate, incisor weakly dentate; palp slender, segment 2 & 3 subequal in length. Maxilla 1, outer plate with 7 apical spines; palp slender, tapering distally. Maxilla 2, inner plate small. Maxilliped, inner plate short, apically setose; outer plate tall, narrow, inner margin strongly spinose; palp segment 2 broad, distal margin subtruncate.

Coxa 3, lower margin shallowly incised. Coxa 4, not broadened, lower margin angular. Gnathopods regular, not sexually dimorphic. Gnathopod 1, carpal lobe large; propod relatively small, little longer than carpus, deflexed distally. Gnathopod 2, basis medium to strongly setose anterodistally; carpal lobe medium strong, not reaching palmar angle; propod expanding and deflexed distally.

Peraeopods 3 & 4 fossorial; segment 4 distally broadened and setose; dactyl large, thick, tips with minute chitinous rings .Coxa 5 medium deep, postero-lobate. Peraeopods 5 & 6 fossorial, segment 4 broadened, setose; dactyls elongate, thick, chitinous rings very small. Peraeopod 7, basis regularly broadened, tapering distally, not incised behind, lacking lower lobe; dactyl elongate, margins setose.

Pleon plates 2 & 3, hind corners obtuse or rounded. Uropods 1 & 2 rami subequal. Uropods 3, outer ramus slightly the shorter. Telson medium, apex truncate or slightly emarginate, weakly armed.

Coxal gills not described.

Brood plates elongate, slightly broadening distally, margins strongly setose.

Taxonomic and distributional commentary. The genus *Rostroculodes* encompasses a group of high arctic species distinguished by the elongate rostrum and apically positioned eyes; antenna 1, peduncular segment 2 elongate; body dorsum slightly rugose, especially in the pleon.

Component species (e.g., *R. schneideri, R. longirostris* and *R. borealis*) have been recorded from sites marginal to the study region (e.g., Pt. Barrow, Alaska, per Shoemaker, 1955) but not yet from the eastern or western North Pacific proper and are not treated further here.

Hartmanodes, new genus

Monoculodes Stimpson (part)—Shoemaker, 1933: 9.—J. L. Barnard, 1962: 111, + key.—Barnard & Karaman, 1991: 559.

Type species. *Monoculodes hartmanae* J. L. Barnard, 1962: 363), present designation.

Species. *Hartmanodes murrius* (J. L. Barnard, 1962: 365); *H. nyei* (Shoemaker, 1933: 9).

Diagnosis. Peraeon and pleon segments 2 & 3 smooth. Rostrum large, apex strongly deflexed. Eyes nearly totally on rostrum, sexually dimorphic. Antennae short, sexually dimorphic. Antenna 1, very short, not attaining end of peduncle of antenna 2; peduncular segment 2 not longer than segment 1, segment 3 medium; flagellum callynophorate in male. Antenna 2, peduncular segment 5 >segment 4; flagellum elongate in male.

Mouthparts not described for any component species.

Coxa 1 little broadened distally. Coxae 2 & 3, lower margins oblique; coxa 3 shallowly incised below. Coxa 4, medium broad, little produced behind. Gnathopods 1 & 2 strongly differing in form and size, not sexually dimorphic. Gnathopod 1, meral process obsolescent; carpus narrow, posterior lobe medium large; propod long ovate, not deflexed distally. Gnathopod 2, basis moderately setose antero-distally; carpus narrow, hind lobe elongate, closely guarding propod, tip exceedingg palmar angle; propod elongate, slightly narrowing distally.

Coxa 5 large, deep, aequilobate. Coxa 6 medium deep. Peraeopods 3 & 4 fossorial, segment 4 distally broadened and setose; segment 5 >6; dactyls slender, medium short, tips with minute chitinous rings.

Peraeopods 5 & 6 fossorial, segment 4 broadened, setose; segment 5 < segment 6; dactyls slender, chitinous rings very small. Peraeopod 7, basis regularly broadened, narrowing distally, postero-distal lobe small, shallow; segment 5 not shorter than 4 & 6; margins of dactyl setose.

Pleon plates 2 & 3, hind corners sharply obtuse. Uropods 1 & 2, rami slightly unequal, shorter than peduncles. Uropod 3, ramis nearly unarmed, outer ramus slightly the shorter. Telson short, not narrowing distally, apical margin nearly straight, apex truncate or slightly emarginate, nearly bare.

Coxal gills large, rectangular.

Brood plates elongate, slightly broadening distally, margins strongly setose.

Etymology. The genus is a combining form, honoring the late Dr. Olga Hartman who contributed extensively to knowledge of the marine invertebrate benthos, particularly the Polychaeta of southern California.

Distributional commentary. The three known species of this genus occur in shallow coastal sands of warm-temperate and subtropical North America, from southern California and the Gulf of California to Florida. It has also been recorded from Brazil (Shoemaker, 1933). No species of the genus were taken in the the study region, and material has not been examined.

Taxonomic commentary. Barnard (loc. cit.) previously noted the strong similarity between these three species. Regrettably, he did not describe or figure the mouthparts of his two species. Shoemaker (loc. cit.) briefly referred to the

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KEY TO SPECIES OF *HARTMANODES*

1. Rostrum lacking ventral keel . . . . . .*H. murrius* (J.L.Barnard).

—Rostrum with ventral keel . . . . . 2.

2. Gnathopod 2, propod elongate > 3X depth; telson weakly notched . . . *Hartmanodes nyei* (Shoemaker)

—Gnathopod 2 regular. length ~2X depth; telson gently convex behind . . *H. hartmannae* (J. L. Barnard)

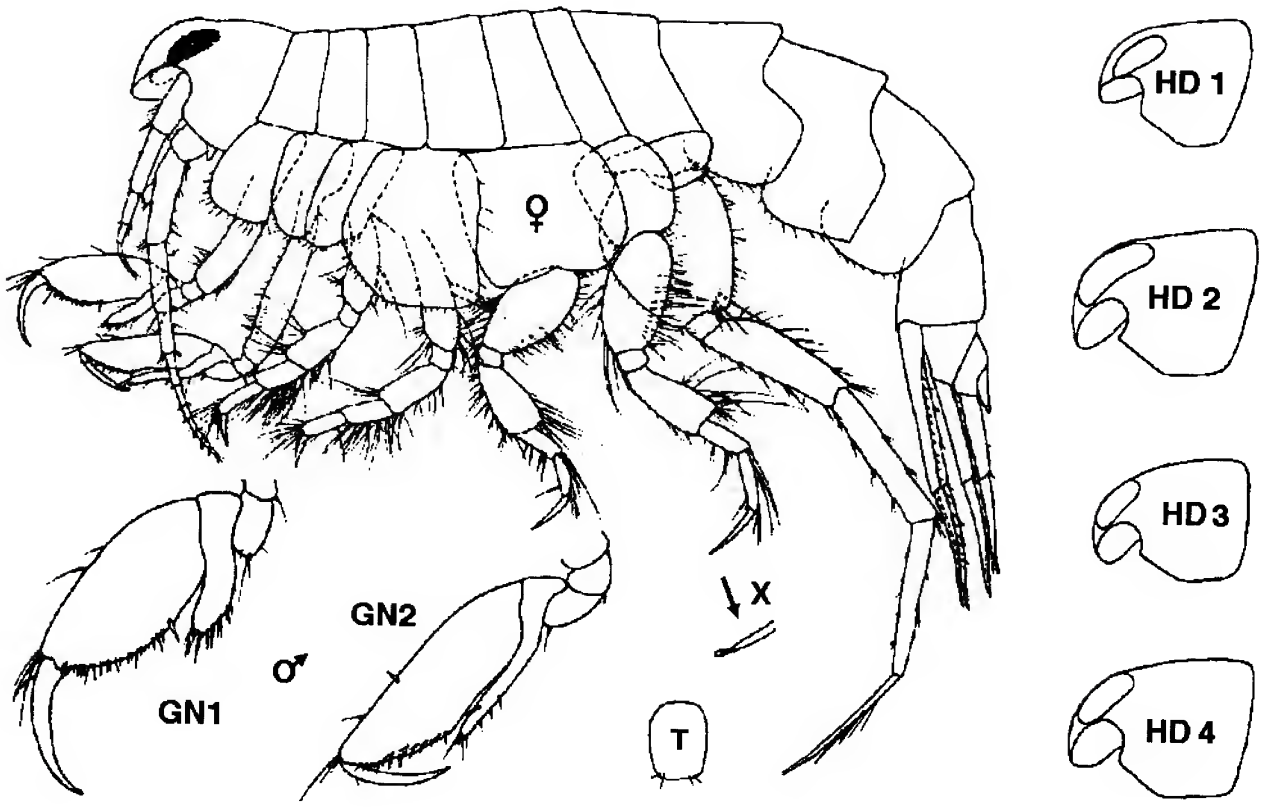

FIG. 10. ***Hartmanodes hartmanae*** **(J. L. Barnard). Off Southern California. Female (4.0 mm); male (3.0 mm). (after Barnard, 1962).**

mandibles and maxilliped but provided no illustrations of the mouthparts pf *H. nyei.*

The authors are reluctant to erect a new genus where some important taxonomic features are unknown and where type material has not been re-examined. However, all three species of the genus were described in legitimate fashion and, as a generic unit, can readily be keyed from all other oedicerotid genera (p. 80). The discovery of additional regional species is anticipated, at which time a full description of the mouthparts and other taxonomically important features would be recommend.

Ameroculodes, new genus

Monoculodes Stimpson, 1853 (part).—Holmes, 1905: 487.—Ledoyer, 1972: 767.—Bousfield, 1973: 95.—Barnard & Karaman, 1991: 559.

Type species. *Monoculodes edwardsi* Holmes, 1905 (present designation).

Species. *Ameroculodes* species (p. 94).

Diagnosis. Head, rostrummedium, not strongly deflexed distally. Eye on basal portion of rostrum. Antennae short, weakly sexually dimorphic, weakly callynophorate in male. Antenna 1, peduncular segment 1 stout, setose; segments 1 & 2 subequal in length; segment 3 large, length <1/2 segment 2; flagellum medium, exceeding peduncle of antenna 2. Antenna 2, peduncular segments 4 & 5 stout, setose; flagellum medium, length not greater than peduncle.

Mouthparts: Mandible, moral large, triturative; left lacinia 5-dentate; palp segment 2 short. Maxilla 1, outer plate with 9 apical spines; palp medium, setose distally. Maxilla 2, inner plate small. Maxilliped, inner plate short, apex with single spine and several setae; outer plate medium, outer margin smooth; palp segment 2 broad, distal margin subtruncate.

Coxa 1 broadened distally, hind margin with spine(s); coxae 2 & 3 relatively broad, spinose behind; coxa 4 large deep, produced posteriorly. Gnathopods 1 & 2 medium, dissimilar, weakly sexually dimorphic. Gnathopod 1, propod large, ovate, not distally deflexed, lower margin convex; carpus narrow, lobe large. Gnathopod 2, propod relatively short, little longer than in gnathopod 1, little narrowing distally; carpus narrow, hind lobe reaching palm.

Peraeopods 3 & 4, segment 4 strongly fossorial, setose; segment 5 > segment 6; segment 6 narrowing distally; dactyls minute. Coxa 5 very large, deep. Peraeopods 5 & 6 short, bases dissimilar; segment 4 strongly fossorial; segment 5 < segment 6; dactyls short, chitinous rings minute. Peraeopod 7, basis proximally broad, postero-distal lobe medium to large; segment 5 not longer than 4 & 6; dactyl elongate, hind margin setose.

Pleon plate 2, hind corner broadly squared or slightly produced, not rounded. Uropods 1- 3, rami unequal, not shorter than peduncles.

Telson medium, apical margin rounded, with 2 slender submedian setae.

Coxal gills large, sac-like, distally rounded. Brood plates slender, marginally and apically setose.

Distributional commentary. The two species of this genus, already referred to in the literature, are endemic to coastal waters of the North American Atlantic coast. Three additional undescribed species are known to one of us (ELB) from estuaries and brackish lagoons of the southeastern United States, from Chesapeake Bay to Florida.

Taxonomic commentary. *Ameroculodes* is distinguished from all other genera by the combination of very large coxal plates; very short dactyls of peraeopods 3-6; broad, truncate segment 2 of the maxilliped palp; and weak sexual dimorphism of the antennae and gnathopod 1.

Its closest affinities are apparently with the genus *Limnoculodes* (fig. 39, p. 138). Its two component species are endemic to fresh and brackish estuaries of warm-temperate and subtropical parts of the Asiatic coast of the North Pacific region, from Hong Kong north to southern Japan.

Ameroculodes edwardsi (Holmes)
(Fig. 11A).

Monoculodes edwardsi Holmes, 1905: 487.—Ledoyer, 1972: 769, figs. 3, 4.—Barnard & Karaman, 1991: 559-60 non *Monoculodes edwardsi* Holmes per Bousfield, 1973: 97,pl. XIX.1.

Taxonomic commentary. The species has been fully described and figured by Ledoyer (loc. cit.), based on material from the Gulf of St. Lawrence.

Ameroculodes species
(Fig. 11B)

Monoculodes sp. (=*M. edwardsi* Holmes, ident. Bousfield, 1973: 97, Pl. XIX.1).—Barnard & Karaman, 1991: 560.

Taxonomic commentary. Barnard & Karaman (loc. cit.) regard the species treated by Shoemaker (1930) and figured by Ledoyer (1972) as correctly assigned to *Monoculodes edwardsi* Holmes, 1905. The species from the Cape Cod region, described and figured under that name by Bousfield (1973), is considered formally undescribed and unnamed.

This study could provide an opportunity to correct this error. However, more pressing would seem the need to describe, simultaneously, the three other Atlantic species (above) for which illustrations have long been in publication-readiness. Such a comprehensive taxonomic study is to be treated in a separate work elsewhere (Bousfield, in prep.).

Kroyera Bate, revived status

Kroyera Bate, 1857: 140.—Bate, 1862: t. 17.
Monoculodes Stimpson 1853 (part).—Sars, 1895: 294.—Barnard & Karaman, 1991: 559.—Ledoyer, 1993: 589.—Ishimaru, 1994: 61.

Type species. *Kroyera carinata* Bate, 1857, by monotypy

Diagnosis. Body, especially pleon, mid-dorsally weakly carinated. Head, rostrum large, strongly deflexed distally; inferior head lobe rounded. Eye nearly totally on rostrum. Antennae short, weakly sexually dimorphic, Antenna 1 short, not reaching end of peduncle 5 of antenna 2, flagellum weakly callynophorate in male; peduncular segment 2 slender, length > segment 1; segment 3 short. Antenna 2, peduncular segment 5 >4; flagellum shorter than peduncle, somewhat elongate in male.

Lower lips broad. Mandible, molar large, triturative; left lacinia 5-dentate; palp slender, segment 3 shorter than segment 2. Maxilla 1, outer plate with 9 apical spines; palp slender, lacking distal setae. Maxilla 2, plates narrow. Maxilliped, inner plate short, apex setose; outer plate slender, outer distal margin setose; palp segment 2 broadening to truncate distal margin; segments 3 & 4 small.

Coxa 1 rounded distally, hind margin with spine(s); coxae 2 & 3 narrow, lower margins oblique; coxa 4 medium, little produced posteriorly. Gnathopods 1 & 2 medium, strongly dissimilar, not sexually dimorphic. Gnathopod 1, propod subovate, slightly distally deflexed; meral process obsolescent; carpus medium, hind lobe large. Gnathopod 2, propod elongate, not narrowing distally; carpus narrow, hind lobe reaching palmar angle.

Peraeopods 3 & 4, segment 4 strongly fossorial, setose; segment 5 <segment 6; segment 6 linear; dactyls minute. Coxa 5 medium large. Peraeopods 5 & 6 differing in length; segment 4 medium, fossorial; segment 5 subequal to segment 6; dactyls very small, chitinous rings not visible. Peraeopod 7, basis regular, postero-distal lobe small; segment 5 longer than 4; dactyl elongate, margins weakly spinose.

Pleon plate 2 broadly rounded behind. Uropods 1- 3, rami and peduncles subequal.

Telson short, apical margin truncate, setae minute.

Coxal gills elongate, sac-like, distally rounded. Brood plates very slender, marginally and apically setose.

Distributional commentary. The monotypic genus is endemic to the European Atlantic and Mediterranean regions. The population in Japanese waters, records of which are summarized by Ishimaru (1994), may prove to be a different species. The record from British Columbia (Wailes, 1931) is considered doubtful (below).

Taxonomic commentary. *Kroyera* is unlike all other genera in its combination of: carinated pleon, minute peraeopod dactyls, short segment 5 of peraeopods 3 & 4, small basis of peraeopod 7, and unique form of the maxillipeds.

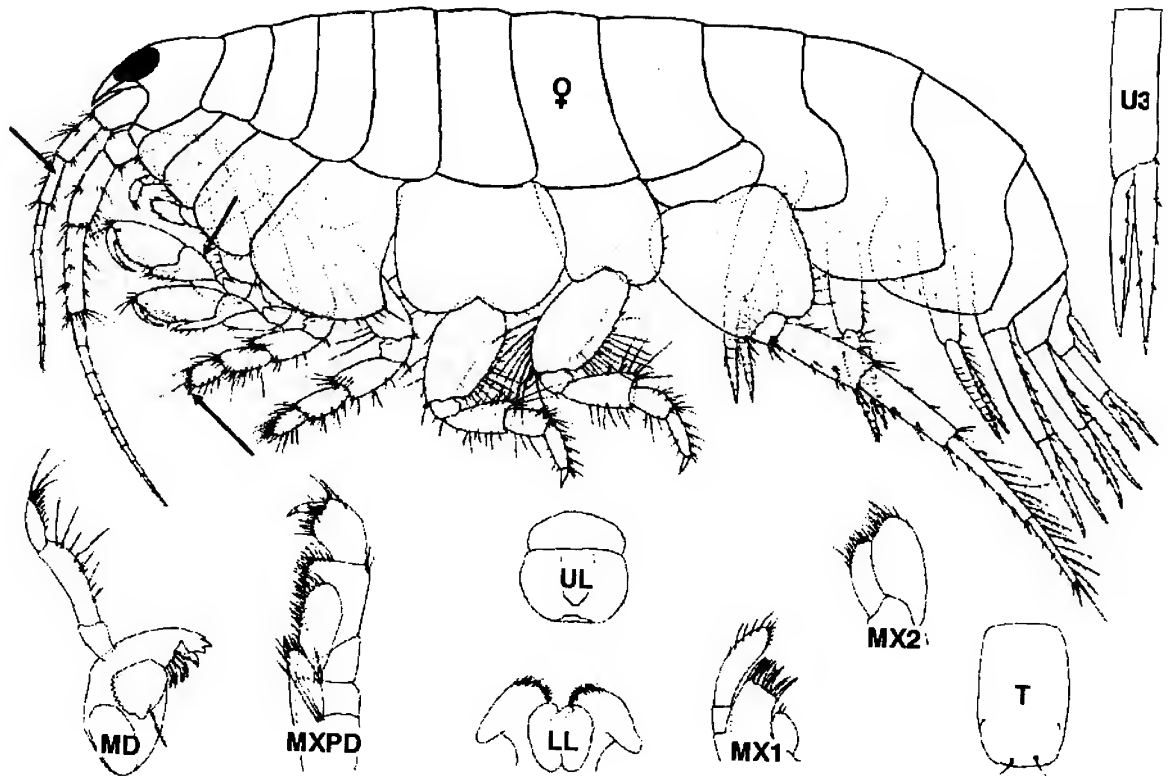

FIG. 11B . *Ameroculodes* species. Cape Cod Region. Female (9.0 mm) (after Bousfield, 1973).

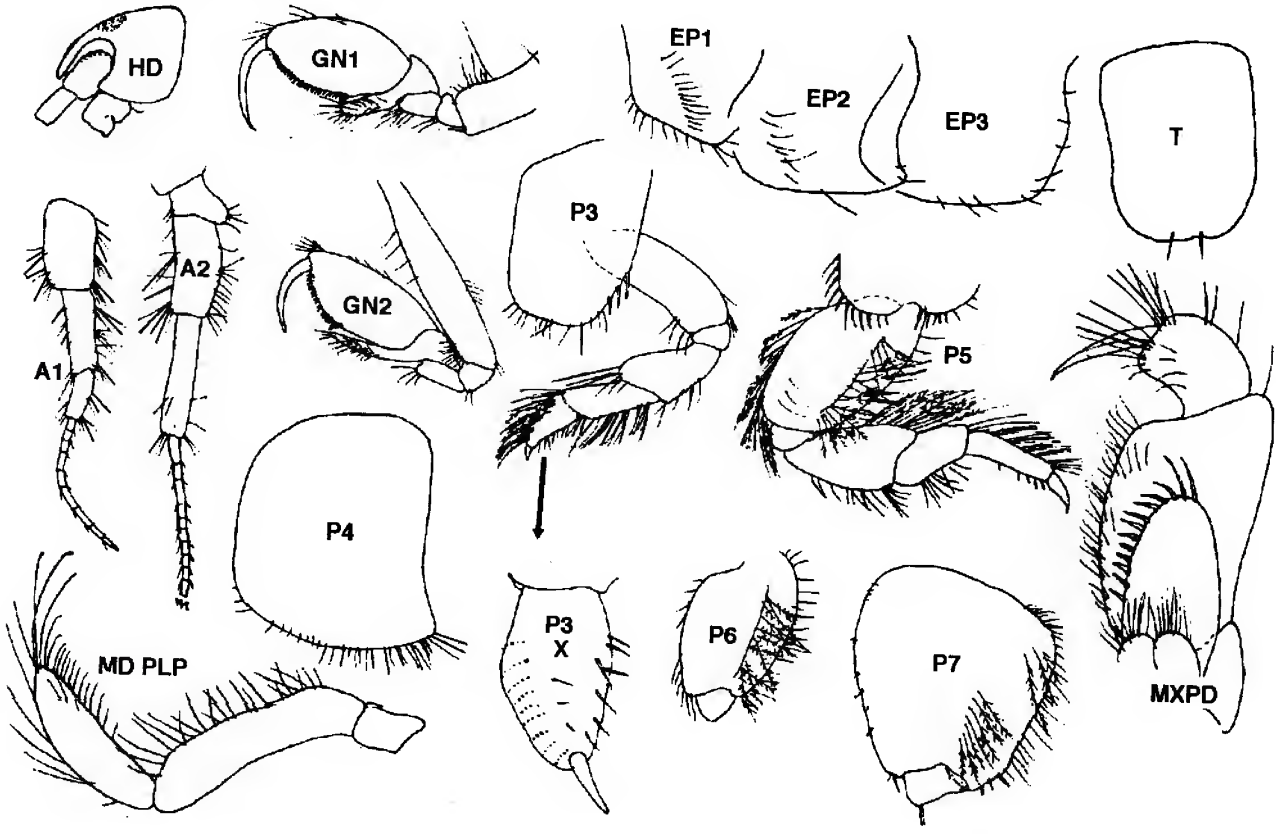

FIG. 11A. *Ameroculodes edwardsi* (Holmes). Chaleur Bay. Female (8.0 mm?) (after Ledoyer, 1972).

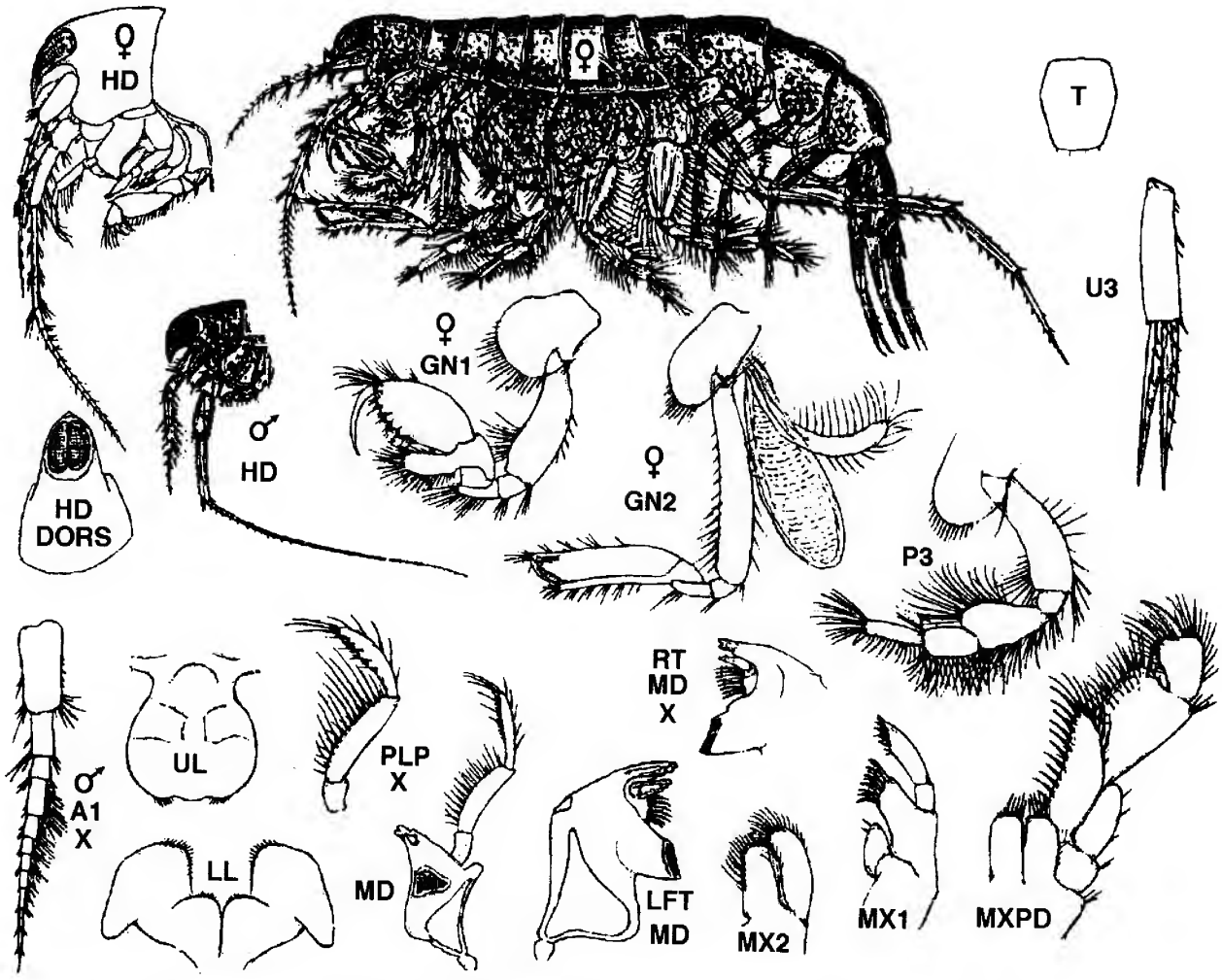

FIG. 12. *Kroyera carinata* Bate. European Atlantic coast. Female (10.0mm); male (8.5 mm). (after G. O. Sars, 1895).

The form of the peraeopods and coxal plates suggests a natural affinity with the genus *Deflexilodes* (fig. 13, p. 99) but *Kroyera* exhibits far more advanced character states. The genus appears convergently similar to *Pacifoculodes* but differs in the large deflexed rostrum, form of the maxillipeds, the small, narrow coxae 1-4, and the differing relative sizes of segments 5 & 6 of peraeopods 3 & 4.

The present decision to revive the genus *Kroyera* is based partly on the original contention of Bate (1862) who noted major taxonomic differences between the N. American Atlantic *M. demissus* Stimpson 1853 and his European Atlantic species, *Kroyera carinata* Bate, 1857. An earlier generic name *Westwoodea*, based on *Westwoodea carinata* Bate, 1856, is considered a nomen nudum by Stebbing, 1906. As noted above (p.78), in rediagnosing the genus *Monoculodes* Stimpson, Barnard & Karaman (loc. cit.) bypassed Stimpson's North American Atlantic type species, *M. demissus*, and selected *"Monoculodes" carinatus* Bate, 1856, as an effective neotype species. This action was apparently predicated on the first use of the name *Monoculodes* for which diagnostically acceptable information was provided. In our view, however, Stimpson's diagnosis, although weak and incomplete, does name a type species, with type locality, and is sufficiently detailed to exclude *M. carinatus* on several generically significant features (above & key, p. 80). Moreover, *Kroyera carinatus* is apparently restricted to the eastern North Atlantic, Mediterranean, and western North Pacific regions.

Kroyera carinata Bate
(Fig. 12)

Kroyera carinata Bate, 1857: 140.
Monoculodes carinatus (Bate, 1857).—Sars, 1895: 295, pl. 105.—Stebbing, 1906: 261.—Lincoln, 1979: 348, fig. 164.—Barnard & Karaman, 1991: 559.—Ledoyer, 1993: 589, fig. 404.—Ishimaru, 1994: 61.
Monoculodes carinatus (Bate)?—Wailes, 1931: 41.—Austin, 1985: 591.

Taxonomic and distributional commentary. *Kroyera carinata* is an advanced member of the *Monoculodes* generic complex in which the propod of gnathopod 2 is elongate, and the peraeopods are strongly fossorial. Diagnosis

with the characters of the genus

Although Wailes' record of *"Monoculodes" carinatus* (Bate) from British Columbia, repeated by Austin (1985), is possibly correct, it is here treated with reservation. His original material is not available for re-examination. No carinated material of the *Monoculodes* complex was found among the several thousand regional specimens of the present study.

Deflexilodes, new genus

Monoculodes Stimpson (part) Stebbing, 1906: 258.—Gurjanova, 1951: 562.—Barnard, 1969a: 383.—Bousfield, 1973: 95.—Lincoln, 1979: 348.—Barnard & Karaman, 1991: 559.—Ledoyer, 1993: 587.

Type species. *Monoculodes tenuirostratus* Boeck, 1871, present designation.

Species: *Deflexilodes intermedius* (Shoemaker, 1930); *D. norvegicus* (Boeck, 1971); *D. tuberculatus* (Boeck, 1871); D. *tesselatus* (Schneider 1884); *D. minutus* (Gurjanova, 1929); *D. rostratus* (Stephensen, 1931)? *D. simplex* (Hansen, 1888); *D. subnudus* (Norman, 1889); *D. similis*, new species (p. 97); *D. gibbosus* (Chevreux 1888); *D. griseus* (Delle Valle, 1893); *D. acutipes* (Ledoyer, 1983; *D. enigmaticus,* new species (p. 99); *D. uncinatus* Bulycheva, 1952). (15 spp.).

Diagnosis. Head, rostrum large, apex variously deflexed. Body, especially pleon segments, smooth or weakly carinated mid-dorsally. Eyes sexually dimorphic, usually partly basal on head. Antennae various, usually slender, sexually dimorphic. Antenna 1 (female) longer than peduncle of antenna 2.

Lower lip broad, inner lobes distinct. Mandible, molar triturative; palp, inner margin of segment 2 with stout setae of irregular length; segment 3 relatively short. Maxilla 1, outer plate with 9 apical spines. Maxilla 2, inner plate broader than outer. Maxilliped, inner plate with apical spine(s) and setae; outer plate medium, broad, narrowed basally; palp segment 2 broadened, distal margin oblique.

Coxal plates normal, deep. Coxa 1 not expanded. Gnathopod 1, carpus long, lower lobe short, not reaching palmar angle; propod distally deflexed, lower margin concave. Gnathopod 2, basis elongate; carpus medium, posterior lobe medium, not closely guarding propod nor exceeding palmar angle; propod broadening distally, spine at postero-distal angle not elongate.

Coxa 4 broadened postero-distally. Peraeopods 3 & 4 weakly to moderately fossorial (segments stout, setose); segment 5 <6; dactyls longer than segment 6, chitinous rings usually small. Coxa 5 deep, aequilobate. Coxa 6 regularly postero-lobate. Peraeopods 5 & 6 subsimilar; segment 5 < 6; dactyls slender, <segment 6, chitinous rings distinct. Peraeopod 7, basis not greatly broadened proximally, hind lobe small or lacking.

Pleon plates 2 & 3 rounded or broadly obtuse behind. Uropods 1 & 3, rami variously unequal, longer than peduncles;

Telson short, apical margin straight or convex, with 4 small spines and/or setae.

Etymology: A combining form of the Latin root "deflectere" - to bend or turn aside, and the suffix "-odes", with reference to the distally deflexed form of the propod of gnathopod 1.

Taxonomic and distributional commentary. The 15+ species of this second largest monoculodid subgroup are centred on the North Atlantic, with outliers in the Arctic and North Pacific regions.

Deflexilodes norvegicus (Boeck)

Monoculodes norvegicus (Boeck) Sars 1895: 301, pl. 107, fig. 1.—Barnard, 1962: 367.—Barnard, 1966: 77.—Barnard & Karaman, 1991: 560.

Material Examined. None from the study region.

Taxonomic and distributional commentary. Barnard (1962) dredged this species widely and abundantly in *Amphipodia-Onuphis* ophiuroid communities at depths of 22-180 m. on the coastal shelf of southern California. Comparing his material with that from northwestern Europe illustrated by Sars (loc. cit.), Barnard noted differences in segment 6 and dactyls of peraeopods 3 & 4 that he suggested might be worthy of new subspecific designation. The Californian material thus awaits full redescription and illustration.

Deflexilodes similis, new species
(Fig. 13)

Monoculodes tuberculatus Boeck (part)?—Gurjanova, 1951: 580.—Barnard & Karaman, 1991: 560.

Material Examined. About 90 specimens, in 14 lots, ranging from Rat I. (Amchitka), south to central and southern B. C.

ALASKA:

Aleutian Islands, Rat I., C. E. O'Clair coll., 1969 - 2 immatures CMN cat no.NMCC1990-0459; Ibid, - female ov (9.0 mm) **Holotype**; male (7.0 mm), **Allotype**; 30 males, 6 imatures, **Paratypes**. CMN cat. no. NMCC1990-0460.

BRITISH COLUMBIA:

North-central coast. ELB Stns., July, 1964: H25 - 4 males, 1 female, 16 immatures (males to 7.0 m; females to 5.5 mm); H34 - 1 immature; H55 - 1 immature.

Swanson Bay, C. Levings Stn. L., 1973 - 1 male.

South-central coast. ELB Stns., Jervis Inlet, May, 1977: E2 - 1 male; E3 - 4 immatures. Burrard Inlet, ELB Stn. P3 (1 km south West Bay), mud and woody detritus, 60 m., Nov. 2, 1977 - 1 male.

Vancouver I., south end. ELB Stns. 1975: P25 - 1 female; P26 (Ives Inlet) - 3 males, 2 female, 9 immatures.

G.W.O'Connell Stn., off Clover Pt., Victoria, Aug., 1976 - 1

KEY TO NORTH PACIFIC SPECIES OF *DEFLEXILODES*

(includes North Atlantic speccies *D. intermedius* (Shoem.) and *D. tenuirostratus* (Boeck)

1. Coxae 1-4 narrow; peraeopod 7, basis broad , depth ~ length . . . . 2.
—Coxae 1-4 broad; peraeopod 7, basis narrow, depth > length . . . . 4.

2. Rostrum slender, nearly straight, not deflexed distally; antennae elongate; telson, apically narrowing, rounded . . . . *D. tenuirostratus* (Boeck)
—Rostrum stout, slightly deflexed apically; antenna short; telson , apex broad, slightly incised . . . . . . 3.

3. Gnathopod 2, propod regular, length ~2X depth; antenna 1, peduncular segment 2 .with antero-distal process or tubercle. . . . . *D. tuberculatus* (Boeck)
—Gnathopod 2, propod elongate, length ~2.5 X width; antenna 1, segment 2 with antero-distal process or tubercle. . . . . *D. norvegicus* (Boeck) (p. 97)

4. Telson elongate, narrowing distally . . . . *D. intermedius* (Shoemaker)
—Telson short-rectangular, distally broad . . . . 5.

5. Coxa 5 broader than deep; peraeopods 5 & 6, dactyls long, >segment 6 . . . . 6.
—Coxa 5 deeper than broad; peraeopods 5 & 6 relatively short, length <segment 6. . . . . *D. similis*, n. sp. (p. 97)

6.Rostrum short <1/2 head length; gnathopod 2, propod margins subparallel. *D. enigmaticus*, n. sp. (p. 99)
—Rostrum long >1/2 head length; gnathopod 2, propod broadening distally . *D. uncinatus* (Buly.) (p.101)

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male, 2 immatures; Nanoose Bay, J.F.L.Hart coll., 1933 - 1 male. CMN collections, Ottawa.
(

Diagnosis. Female (7.0 mm). Body, including pleon, dorsally smooth. Head, rostrum strong, slightly deflexed distally; anterior head lobe acute. Eye large, partly on rostrum. Antenna 1, peduncular segment 2 shorter than 1, antero-distal process weak; segment 3 ~1/2 segment 2; flagellum medium, 7-10 segmented, exceeding peduncle of antenna 2. Antenna 2, peduncular segments 4 & 5 subequal; flagellum ~12-segmented, shorter than peduncle.

Lower lip medium broad. Mandible: molar reduced, weakly triturative; spine row with 6 slender blades; palp large, segment 3 long, arched, inner margin strongly setose. Maxilla 1, palp slender, outer distal margin of segment 2 weakly setose. Maxilliped, inner plate very short, apical margin with long stiff setae; outer plate medium, outer margin convex; palp segment 2 moderately broadened distally.

Coxa 1-4, lower margins strongly setose. Coxa 1 little broadened distally, hind margin with short spines. Coxa 3 much broader than 2 ; coxa 4 as broad as deep, little produced behind. Gnathopod 1, basis, margins distally setose; meral process short; carpus longer than deep, hind lobe medium, barely attaining postero-distal angle of palm; propod relative small, slender, very slightly deflexed distally. Gnathopod 2, basal margins distally setose; carpus short, hind lobe slender, apex attaining postero-distal angle; propod slender slightly broadening distally, length ~2.5 X depth.

Peraeopods 3 & 4, bases strongly setose antero-distally; segment 4 weakly fossorial; segment 6 sublinear, setose posteriorly and antero-distally; dactyl slender, subequal in length to segment 6, tips with minute chitinous rings.

Coxa 5 broad, medium deep, aequilobate. Coxa 6 medium; both coxae strongly setose below. Peraeopod 6 distinctly larger than 6; segment 4, margins strongly setose; dactyls very slender, subequal in length to linear segment 6. Peraeopod 7, basis medium broad, hind margin slightly incised, postero-distal lobe weak; segment 5 >segment 4.

Pleon plate 2, hind margin obtusely rounding, finely setose throughout. Uropods 1 & 2, outer ramus the shorter, margins nearly bare; uropod 3, subequal rami longer than peduncle.

Telson subrectangular, apical margin gently convex, weakly emarginate, with pair of short setae medially and disto-laterally.

Coxal gills sac-like, broadening distally. Brood plates strap-like, slightly broadening distally, distal margin long-setose.

Male: (6.0 mm). Antenna 1, flagellum, basal segments 12-segmented,basally conjoint but not callynophorate. Antenna 2 elongate; peduncular segment 5 slightly longer than 5, both with anterior marginal brush setae.

Etymology. From the Latin "*similis*" - like, and the root name "*tuberculatus*", with reference to the close similarity of this species to *Deflexilodes tuberculatus* Boeck, 1871.

Distributional ecology. Bering Sea to southern British Columbia,subtidally on coarse sand to silty sand bottoms, at depths of 12 - 30+ m.

Taxonomic commentary. *Deflexilodes similis* is closely related to *D. tuberculatus* Boeck from western European waters and recorded by Gurjanopva (loc. cit.) from the

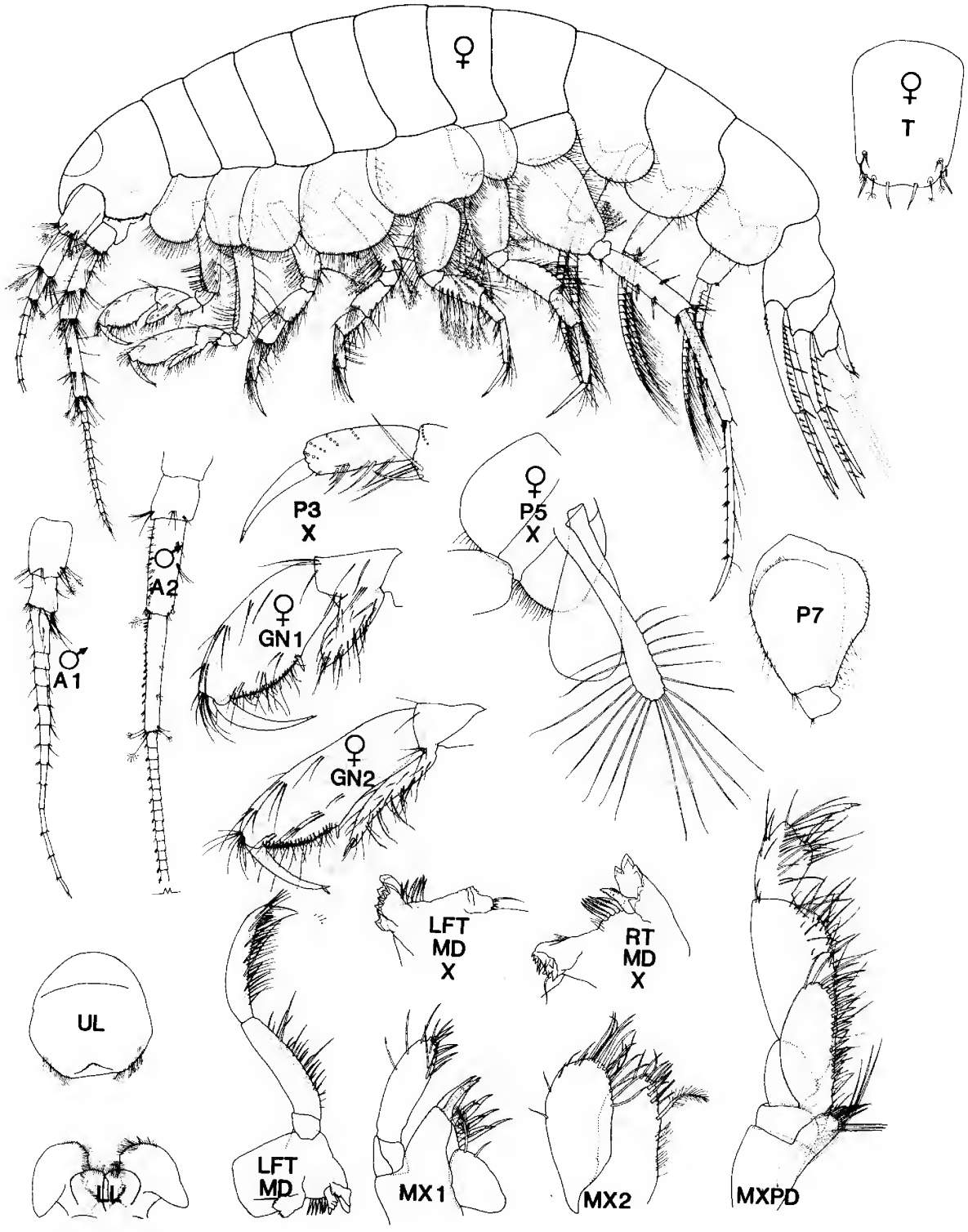

FIG. 13. ***Deflexilodes similis,*** **new species. Rat. I., Alaska. Female (9.0 mm); male (6.0 mm).**

Deflexilodes enigmaticus, new species
(Fig. 14)

Material Examined.

ALASKA:

Southeastern Alaska. ELB Stns., 1961: A84 (1 female); A115 (1 male, 4 females, 4 immatures, CMN cat. no. NMCC1990-1162.

ELB Stns., July, 1980: S1F1 (Leo Anchorage), stones & kelp, 6-10 m. - 1 female (6.0 mm), **Holotype**, 1 male (4.0 mm), **Allotype**. CMN Collections, Ottawa.

BRITISH COLUMBIA:

South-central coast. ELB Stns., English Bay, June, 1976: EB7, muddy sand , 26 m. - 1 male, 2 females, 3 immatures; EB8, mud, 40 m - 2 males; 3 females, 5 immatures; ELB

Stns., Nov., 1977: P01, 44-50 m - 2 specimens.
ELB Stns., 1978: ELB Stn. V4 (Burrard Inlet), sandy mud, shell, 50 m. - 2 males, 4 females, 9 immatures.
Vancouver Island, north end, ELB Stns., 1975: P21a (Gooding Cove), coarse sand, 12-14 m. - 2 females, 1 immature; P21b, sand, 8 m. - 1 male, 2 females, 6 immatures; P21c, fine sand, 8 m. - 2 males, 14 females, 3 immatures. [slide mounts of female (8.0 mm), male (4.0 mm)].
Vancouver I., south end. ELB Stns., May, 1977: B3 (Departure Bay), mud & woody debris, 17-33 m - 4 specimens.

Diagnosis. Female (6.0 mm). Body dorsally smooth. Head, rostrum very strong, deflexed distally; anterior head lobe subacute. Eye large, mainly on rostrum. Antenna 1, peduncular segment 2 shorter than 1, lacking antero-distal process; segment 3 short, ~1/3 segment 2; flagellum medium, ~10 segmented, slightly exceeding peduncle of antenna 2. Antenna 2, peduncular segments 4 & 5 subequal; flagellum not longer than peduncle.

Lower lip broad, shallow. Mandible: molar reduced, weakly triturative; spine row with 5-6 slender blades; palp medium large, segment 3 somewhat shorter than segment 2. Maxilla 1, palp medium, outer distal margin of segment 2 weakly setose. Maxilliped, inner plate very short, apical margin with short spine and stiff setae; outer plate medium, outer margin strongly convex; palp segment 2 stout, distal margin oblique.

Coxa 1-4 successively increasing in size, lower margins gently convex, moderately setose. Coxa 1 little broadened distally, hind margin nearly bare. Coxa 4 broader than deep, produced behind. Gnathopod 1, basis, margins distally setose; meral process short, acute; carpus longer than deep, hind lobe short, broad, not attaining postero-distal angle of palm; propod relative short, deep, deflexed distally. Gnathopod 2, basis, antero-distal margin setose; carpus short, hind lobe slender, apex with stout spine, attaining postero-distal angle; propod slender slightly broadening distally, length ~2.5 X depth.

Peraeopods 3 & 4, setose antero-distally; segment 4 moderately strongly fossorial (broadened and setose distally); segment 6 slightly arched, strongly setose behind and antero-distally; dactyls slender, much longer than segment 6, tips lacking chitinous rings.

Coxa 5 broad, medium deep, aequilobate. Coxa 6 medium; both coxae strongly setose below. Peraeopods 6 and 6 subsimilar; segment 4 medium stout, margins strongly setose; dactyls very slender, longer that respective segment 6. Peraeopod 7, basis not strongly broadened proximally, hind margin straight, postero-distal lobe small; segment 5 not longer than segment 4.

Pleon plate 2, hind margin broadly rounding, nearly bare throughout. Uropods 1 & 2, rami closely subequal, shorter than peduncles, margins moderately spinose; uropod 3 not present.

Telson short-rectangular, apical margin slightly emarginate, with pair of widely spaced short spines and disto-lateral short setae.

Coxal gills sac-like, rounded distally. Brood plates broadly strap-like, distally with long marginal setae.

Male: (4.0 mm). Rostrum less strongly deflexed. Eye much larger. Antenna 2 elongate; peduncular segment 4 not longer than 5, both with weak anterior marginal brush setae.

Etymology. From the Latin "*enigma*" - puzzling, with reference to the unexpected occurrence of a species that is very similar to a species described originally from the Atlantic coast of North America.

Distributional ecology. Southeastern Alaska to southern British Columbia, subtidally on coarse sand to silty sand, at depths of 6-50 m.

Taxonomic commentary. In nearly all major character states, *Deflexilodes enigmaticus* is closely similar to *D. intermedius* (Shoemaker, 1930), from the the northeastern American Atlantic region (per Bousfield, 1973; Watling, 1981). However, *D. enigmaticus* differs in characters of the key and in addition, the maxilliped outer plate is distinctly broader, the propod of gnathopod 2 is less elongate, the propods and dactyl of peraeopod 7 is less setose, and the telson is somewhat shorter and broader than in *D. intermedius*.

Some variation in the form of the rostrum, relative size of peduncular segment 2 of antenna 1, and in body size of mature specimens throughout the present study range has been noted. Pending further analysis, however, the variations are not considered of species level significance.

Deflexilodes uncinatus (Bulycheva)
(Fig. 15)

Monoculodes uncinatus Bulycheva, 1952: 210, fig. 12.—Barnard & Karaman, 1991: 560.

Diagnosis. Male (7-8 mm): Rostrum relatively short, < 1/2 total head length, apex moderately deflexed. Antenna 1, flagellum 10-segmented. Antenna 2, pedunc. segment 5 > 4.

Coxa 1 little broadened distally; coxa 2 with 3-4 hind marginal spines. Gnathopod 1, basis, anterior margin with with strong median setae; propod short, broad. Gnathopd 2, propod broadening distally, lower margin gently convex.

Peraeopods 3-6 moderately fossorial, setose; dactyls elongate, >> segment 6, tips with small but distinct chitinous rings. Peraeopod 7, basis not broadly expanded.

Telson subrectangular, apex very slightly emarginate.

Taxonomic and distributional commentary. *Deflexilodes uncinatus* has been recorded from Peter-the-Great Bay, northern Sea of Japan, subtidally at depths of 28-71 m. Morphologically, it appears closest to *D. enigmaticus,* the most northerly species of the North American Pacific coast (see key, p. 99). However, the mouthparts, uropods, and other diagnostic characters, as well as the female, await more complete description.

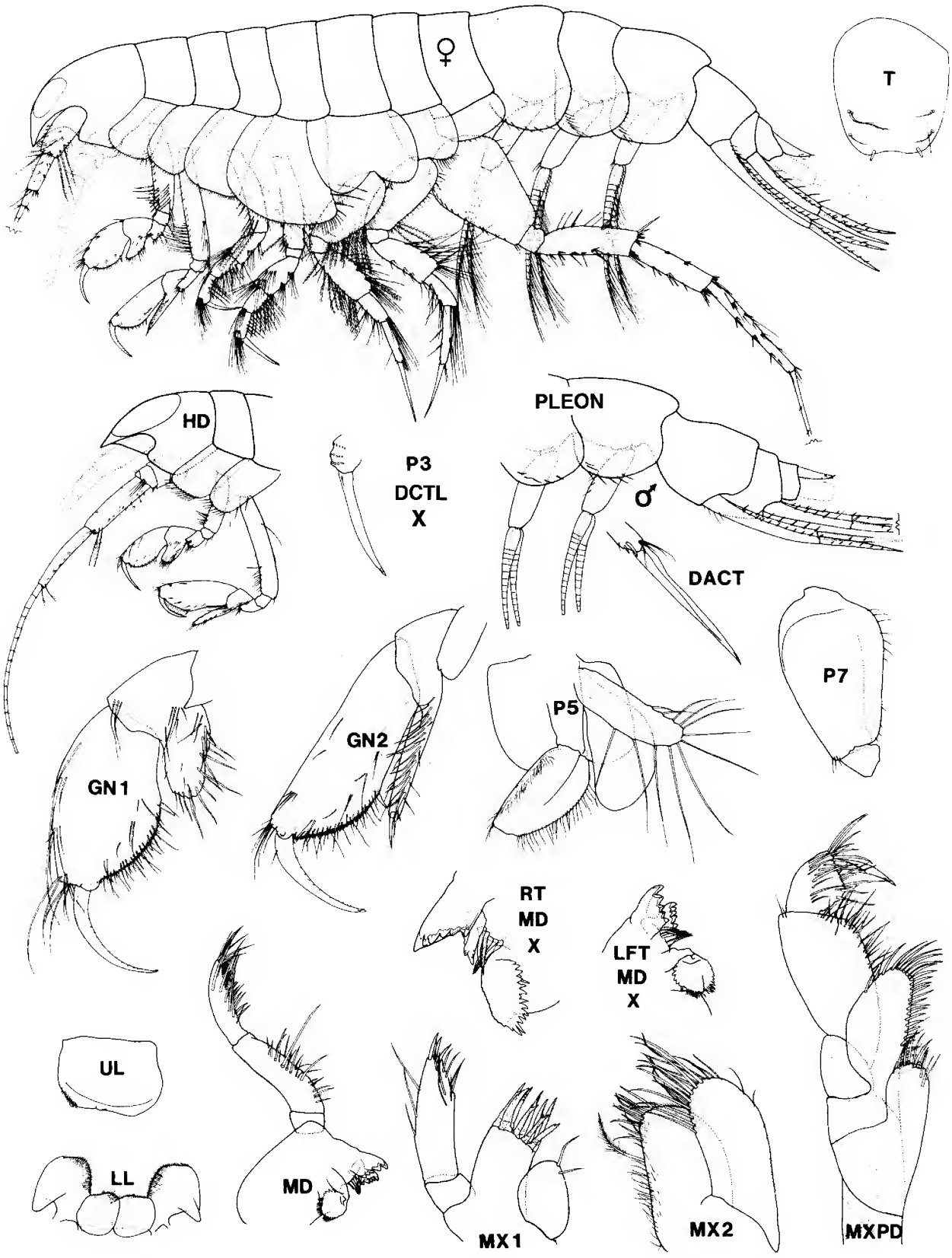

FIG. 14. ***Deflexilodes enigmaticus,*** **new species. Leo Anchorage, Southeastern Alaska. Female (6.0 mm); male 4.0 mm)**

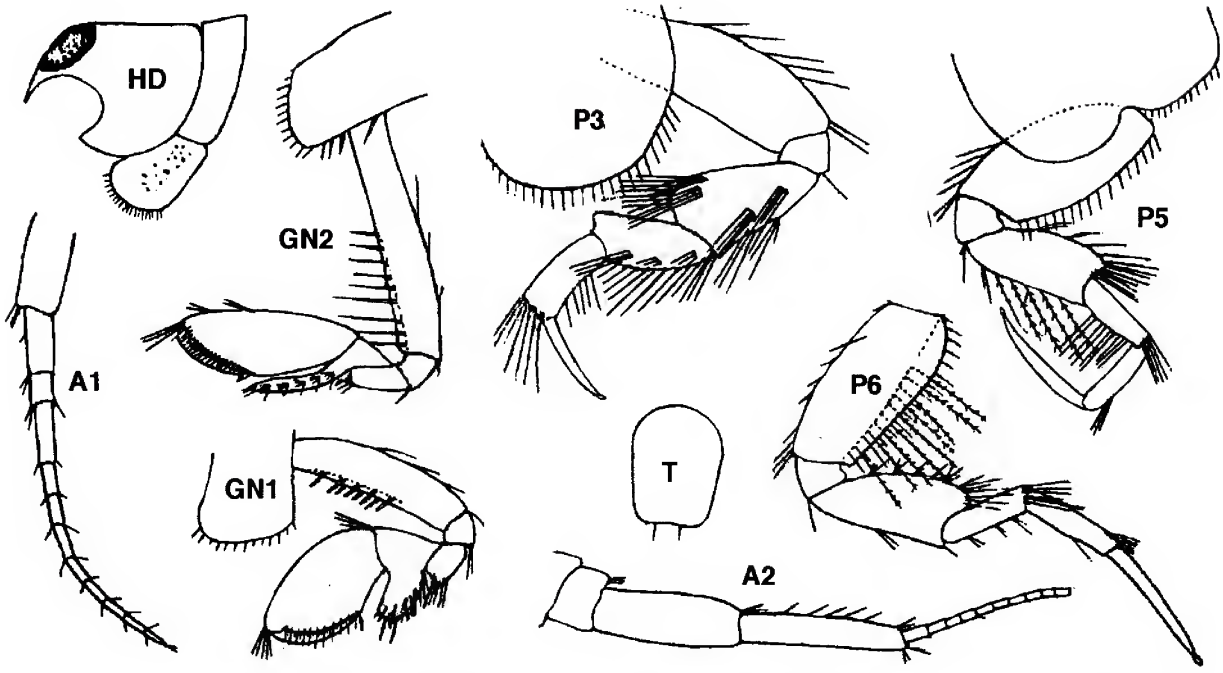

FIG. 15. ***Deflexilodes uncinatus*** **(Bulycheva). Peter-the-Great Bay, 28-71 m. Male (7-8 mm). (after Bulycheva, 1952).**

Pacifoculodes, new genus

non *Monoculodes* Stimpson, 1853: 41.
Monoculodes Stimpson (part) Gurjanova, 1951: 566.—Bulycheva, 1952: 209.—Mills, 1962: 9.—Barnard, 1962: 356 (+key).—Barnard, 1969a: 383.—Ledoyer, 1972: 767.—Barnard & Karaman, 1991: 559.

Type species. *Monoculodes spinipes* Mills, 1962: 12, present selection.

Species. *Pacifoculodes zernovi* (Gurjanova, 1938); *P. nasutus* (Bulycheva, 1952); *P. breviops* (Bulycheva, 1952); *P. levingsi,* new species; *P. barnardi,* new species; *P. levingsi,* new species; *P. crassicornis* (Hansen (per Gurjanova, 1951, but not Ledoyer, 1972)); *P. pallidus* (Sars, 1895); *P. dembiensis* (Bulycheva, 1952); *P. synophthalmus* (Bulycheva, 1952); *P. bruneli*, new species. (12 spp.).

Diagnosis. Medium to large monoculodids, characterized by: head, rostrum regular, usually not strongly deflexed; fused eyes partly or wholly on rostrum; anterior head lobe acute or sharply rounded, inferior margin oblique. Body smooth above, often maculated in colour. Antenna 1 short to medium; peduncular segment 2 subequal to segment 1; segment 3 not elongate. Antenna 2 longer than antenna 1; peduncular segment 4 & 5 setose.

Lower lip broad, inner lobes separated. Mandible, molar with triturative apex; spine row with 4-6 blades; incisor toothed; left lacinia 5-7 dentate, right lacinia irregularly bifid; palp segment 3 variously shorter than segment 2. Maxilla 1, outer plate with 9 apical spine teeth; palp segment 2 stout, setose. Maxilla 2, outer plate not broadened. Maxilliped; inner plate apically setose; outer plate tall, outer margin convex, inner strongly masticatory; palp segment 2 broad, distally subtruncate.

Coxa 1 distally broadest, lower margin strongly setose. Coxa 2 narrow, lower margin variously oblique, hind margin with longish spines. Coxa 3 regularly deep, rounded below, hind margin spinose. Gnathopods not sexually dimorphic. Gnathopod 1, basis antero-distally setose; propod large, longer than deep, hind margin short; carpus, anterior margin medium to narrow, posterior lobe large, extending beyond palmar angle. Gnathopod 2, basis elongate, antero-distally setose; propod elongate ~2-4 X maximum depth, often narrowing distally; palm oblique; carpus, anterior margin narrow; postero-distal lobe slender, elongate, usually closely guarding propod throughout.

Coxae 4 broadened distally, hind corner acute, produced. Peraeopods 3 & 4, segments 4-6 strongly setose; segment 5 longer than 6; dactyls slender, much shorter than, and overhung anterodistally by segment 6. Coxa 5 deep, weakly posterolobate. Coxa 6 mediumdeep. Peraeopods 5 & 6, segment 4 stout, broadest distally; segment 5 shorter than 6; dactyls short to medium, not (or little) longer than segment 6. Peraeopod 7 large, elongate, basis very broad proximally, hind margin convex, narrowing distally to distinct lower hind lobe; segments 4-7, margins spinose.

Pleon plate 2, hind corner quadrate to acutely produced; plate 3 rounded behind. Pleopods regular. Uropod 1, outer ramus often the shorter Uropod 3 large, rami strong, margins spinose. Telson, apical margin straight or slightly incised, with 2 pairs of unequal setae.

Coxal gills large, sac-like. Brood plates setose marginally and apically.

Etymology: A combining form of the geographical name "Pacific-" and the suffix "*-oculodes*", with reference to the mainly North Pacific-endemic occurrence of component species.

Distributional Ecology. Component species occur in shallow shelf waters of the North Pacific region, mainly on clean surf-exposed sands, from the shoreline to 50 m. .deep

Taxonomic Commentary. This genus differences from the type genus *Monoculodes* in characters of the key, and in addition: *Pacifoculodes* is an advanced member of the *Moncoulodes* complex in virtually all character states considered here (see fig. 1, and phenogram, fig. 39, p. 138).

Pacifoculodes spinipes (Mills)
(Fig. 16)

Monoculodes spinipes Mills, 1962: 12, fig. 3.—Austin, 1985: 591.—Staude, 1987: 378.—Barnard & Karaman, 1991: 560.
non *Monoculodes spinipes* Mills, cf. Barnard, 1962: 368, fig. 10.

Material Examined: More three thousand specimens in 64 station lots, from Nahannie Beach, Oregon, north through Washington state and British Columbia to the north coast of the Queen Charlotte Islands:

BRITISH COLUMBIA.
Queen Charlotte Islands. ELB Stn. H11 (Old Massett beach), July, 1957 1 female; Virago Sound, J. W. Scoggan Stn., 1965 - 1 female.
North-central mainland coast. ELB Stns., July, 1964: ~28 specimens at H1, H37, H59 (Calvert I to Open Bight) .
ELB Stn. N6 (Raynor Pt), July, 1959 - 29 specimens.
Vancouver Island, south end. ELB Stns., July, 1955: 20 specimens at P4, P6a (Long Beach), P8.
ELB Stns., July, 1970: ~310 specimens at P703, P707, P708, P711, P713; P703 (McKenzie Beach) - 17 males **(fig'd specimen),** 11 females **(fig'd. specimen)**, 14 immatures.
ELB Stns., August, 1964: ~340 specimens at H40, H41, H44.
ELB Stns., July, 1975: ~320 specimens at P1a, P4a, P8, P14a, P21a, P21b.
ELB Stns., July, 1976: 28 specimes at B4, B12a, B21, B23.
ELB Stns., May, 1977: 225 specimens at B17, B18, B19b.

WASHINGTON:
ELB Stns., July, 1966: Approxiately 2300 males, females, and larger immatures, at 11 outer coast stations (W14, W16, W18, W20, W22, W24, W33, W34, W40, W45, W46).
OREGON:
ELB Stns., August, 1966: 9 specimens at stations W50, W52, W53.

Diagnosis. Female ov. (8.5 mm): Head, rostrum regular, little deflexed distally, slightly exceeding peduncular segment 1; anterior head lobe bluntly rounded. Eye medium, partially on base of rostrum. Antennae medium, regular, not elongate. Antenna 1 peduncular segment 1 relatively short, thick anteriro-distally setose; peduncle slightly shorter than 1, setose segment 3 relatively long, >1/2 segment 2.; Antenna 2, p[eduncular segments 4 & 5 subequal in length, margins heavily setose; flagellum not longer than peduncle, 20-25 segmented..

Lower lip medium broad, inner lobes distinct. Mandible, left lacinia 5-dentate; right lacinia bifid; spine row with 5-6 blades; palp segment 3 short, outer margin distally setose, length <heavily setose segment 2. Maxilla 1, palp segment 2 outer margin setose distally. Maxilliped, inner plate short, apex 8-10 setose; outer plate medium broad with 2-3 outer distal setae; palp segment 2 broadening distally, distal margin slightly oblique.

Coxa 1 broadening distally, strongly setose below, hind margin each with 1 spines. Coxa 2, distal margin slightly oblique, hind margin with 3-4 spines Gnathopod 1, meral process strong; carpus narrow, hind lobe large, long, extending well beyond palmar angle; propod long ovate, length nearly twice depth, oblique palm much longer than posterior margin. Gnathopod 2, basis setose antero-distally; carpus very narrow, hind lobe slender, closely masking proopod, apex distinctly exceeding palmar angle, lower margin with 8-10 clusters of setae; propod slender, narrowing slightly distally to oblique palm, length ~3X maximum depth, inner face anterodistally with 4-5 clusters of setae.

Coxa 4 greatly broadened distally, moderately setose below; apex subacute. Peraeopods 3 & 4, doistal segments strongly setose behind; segment 4 very stout, setose antero-distally; segment 5 slightly longer than 6; dactyls slender, very short. Coxa 5 very brioad, deep, aequilobate. Coxa 6 deep, weakly posterolobate. Peraeopods 5 & 6 unequal in size; segment 4 regularly broadening distally, margins thickly setose; segment 6 short spinose anteriorly; dactyls short, length ~2/3 segment 6. Peraeopod 7, basis very broad proximally, hind margin gently convex, postero distal lobe large, broadly rounding depth greatly exceeding ischium; segment 6 longer than 5, not shorter than 7.

Pleon plate 2, hind corner acutely produced; pleon plate 3 broadly obtuse behind. Uropod 1, outer ramus distinctly the shorter; uropod 2, rami subequal, longer than peduncle; uropod 3, rami subeuqal, longer than peduncle apices extenidng well beyond uropods 1 & 2. Telson narrowing slightlyt distally, hind margin shallow convex, with centre pair of slender spines inside of pair of very short setae.

Coxal gills relatively short, subrectangular. Brood plates narrow, apically and marginally long-setose.

Male (4.5 mm). Single specimens subadult, little differing from female. Antenna 1 shorter than anteenna 2, flaegllum 1-2 segmented, proximal segments callynophorate but not fused. Antenna 2,peduncle 5, with asclustyers of short anterior marginal setae; flagellum nearly equal in length to peduncle, 17-segmented.

KEY TO SPECIES OF *PACIFOCULODES*

(not including P. pallidus Boeck-of doubtful synonymy?)

1. Rostrum large, apex reaching nearly to peduncular segment 2 or antenna 1; peraeopods 5 & 6, dactyls large, length ~ segment 6 . . . . .2.
—Rostrum medium, apex reaching ~ halfway (or less) along peduncular segment 1 of antenna 1; peraeopods 5 & 6; dactyls medium, length <segment 6. . . . . 3.

2. Fused eyes entirely on rostrum; peraeopod 7, basis deeper than wide . . . . *P. zernovi* (p. 110)
—Fused eyes only partially on rostrum; peraeopod 7, basis very broad, distinctly wider than deep . . . .*P. nasutus* (p. 112)

3. Pleon plate 2, hind corner subquadrate; gnathopod 2, propod elongate, length ~4 X maximum depth, distinctly narrowing distally . . . . 4.
—Pleon plate 2, hind corner acute or subacute; gnathopod 2, propod relatively short, length about 2-3 X maximum depth ,not (or slightly) narrowing distally . . . . 5.

4. Rostrum nearly straight, not deflexed distally; fused eyes partially on head and rostrum; coxa 1 little broadened distally, lower margin nearly straight . . . . *P. levingsi* (p. 108)
—Rostrum deflexed apically; eyes wholly on rostrum; coxa 1 strongly broaded distally lower margin strongly convex . . . . *P. breviops* (p. 112)

5. Peraeopods 5 & 6, segment 4 stoutly pyriform, width = length . . . .*P. dembiensis* (p. 112)
—Peraeopods 5 & 6, segment 4 regularly broadening distally, width 1/2-2/3 length . . . . 6.

6. Peraeopod 7, basis, postero-distal lobe narrow, subacute below . . . . *P. synophthalmus* (p. 112)
—Peraeopod 7, basis, hind lobe broadly rounded below . . . . 7.

7. Pleon plate 2, hind corner subacute, not produced; peraeopods 5 & 6, dactyls medium, length > 2/3 respective segment 6 . . . . 8.
—Pleon plate 2, hind corner acutely produced; peraeopods 5 & 6, dactyls short, length < 2/3 respective segment 6 . . . . .9.

8. Coxa 4 distally very broad, width ~= length (depth); coxa 2, posterior margin with 1-2 spines; peraeopods 3 & 4, dactyls medium, length >1/4 respective segment 6 . . . . *P. barnardi* (p. 105)
—Coxa 4 medium broad, width 2/3 depth; peraeopods 3 & 4, dactyls very short, length <1/4 segment 6; coxa 2, hind margin with 4-5 spines . . . . *P. crassirostris* (p. 108)

9. Peraeopod 7, segment 7 (dactyl) elongate, length >segment 6; coxa 6 weakly postero-lobate; peraeopods 5 & 6 dactyls medium, length >1/2 segment 6; antenna 2, peduncular segments 4 & 5 thickly setose . . . . *P. spinipes* (p. 102)
—Peraeopod 7, segment 7 normal, length< segment 6; coxa 6 strongly posterolobate; peraeopods 5 & 6, dactyls short, thick, length <1/2 segment 6; antenna 2, peduncular segments 4 & 5 regularly setose . . . . *P. bruneli* (p. 105)

Distributional ecology. Dominant in surf zone of open sandy beaches, from northern British Columbia to Washington, Oregon, and northern California.

Taxonomic commentary. *Pacifoculodes spinipes* is closely similar in morphology and life style to its more northerly sibling counterpart, *P. bruneli* (Fig. 41, p. 141). The species differ in characters of the key and in body size. The the line of demarcation between the two populations is Dixon Entrace, between Southeastern Alaska and the Queen Charlotte Islands.

Pacifoculodes barnardi, new species
(Fig. 17).

non *Monoculodes spinipes* Mills, cf. J. L. Barnard, 1962: 368, fig. 10.—Barnard & Karaman, 1991: 560 (part).

Material. The holotype is here designated as the 4.5 mm unsexed immature specimen of J. L. Barnard, 1962, fig. 10, from R/V Velero Stn. 4818, off Pt. Conception, California, deposited in the collections of the Allan Hancock Foundation, Santa Inez, California. The paratype in an unsexed immature

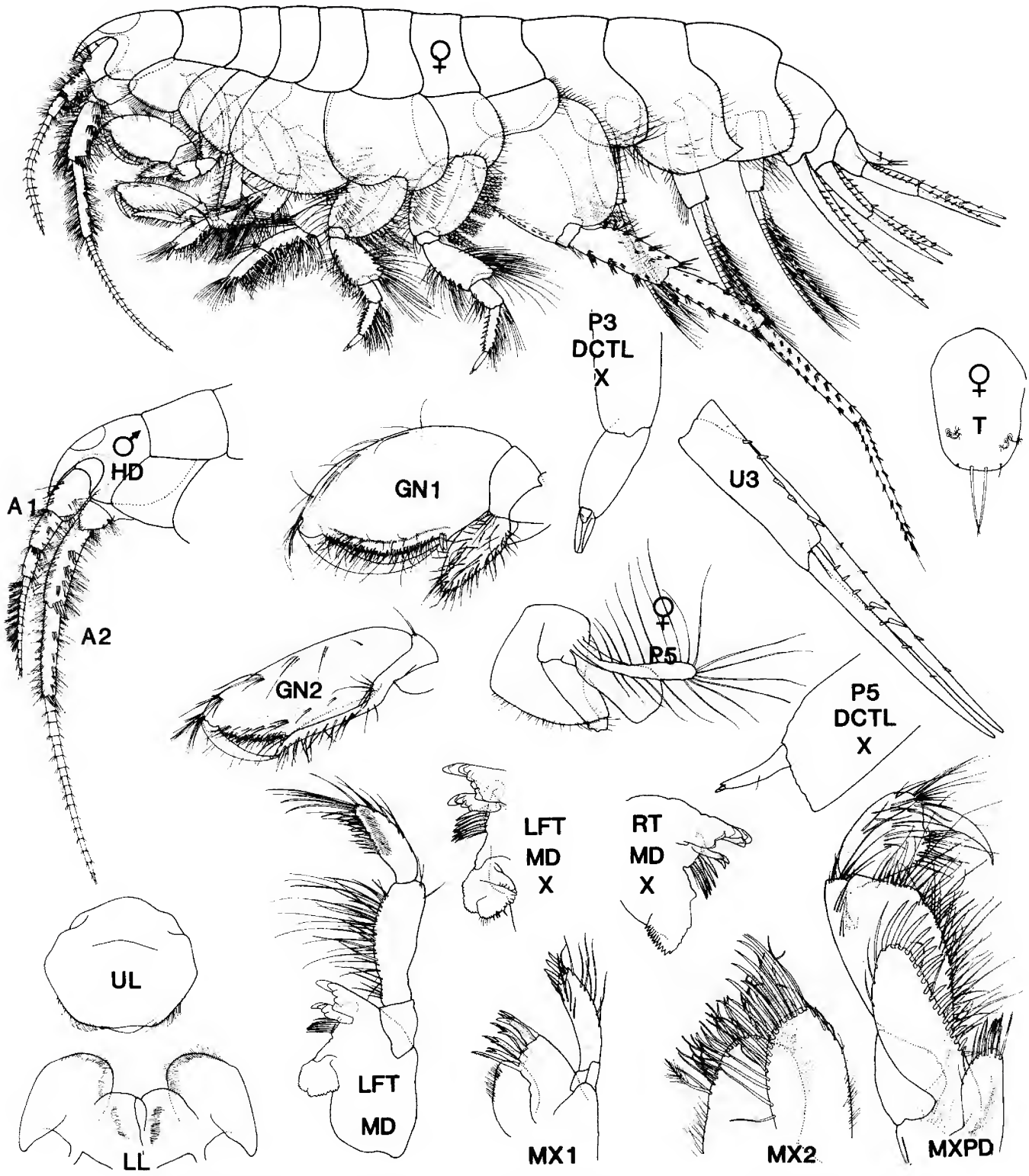

FIG. 16. ***Pacifoculodes spinipes*** **(Mills). McKenzie Beach, Vancouver Island, B. C. Female (11.0 mm); male (6.0 mm).**

from Velero Stn 4819. The specimens were not examined by the present authors.

Diagnosis. Unsexed immature specimen (4.5 mm): Head, rostrum regular, little deflexed distally, not reaching tip of peduncular segment 1 of antenna 1. Eye medium, partially on base of rostrum; lateral head lobe oblique, upper angle sharply rounded. Antennae medium, peduncles weakly setose. Antenna 1 longer than peduncle of 2; peduncular segments 1 & 2 subequal in length; segment 3 about 1/2 length of 2.; flagellum 8-segmented. Antenna 2, flagellum not longer than peduncle, ~15 segmented..

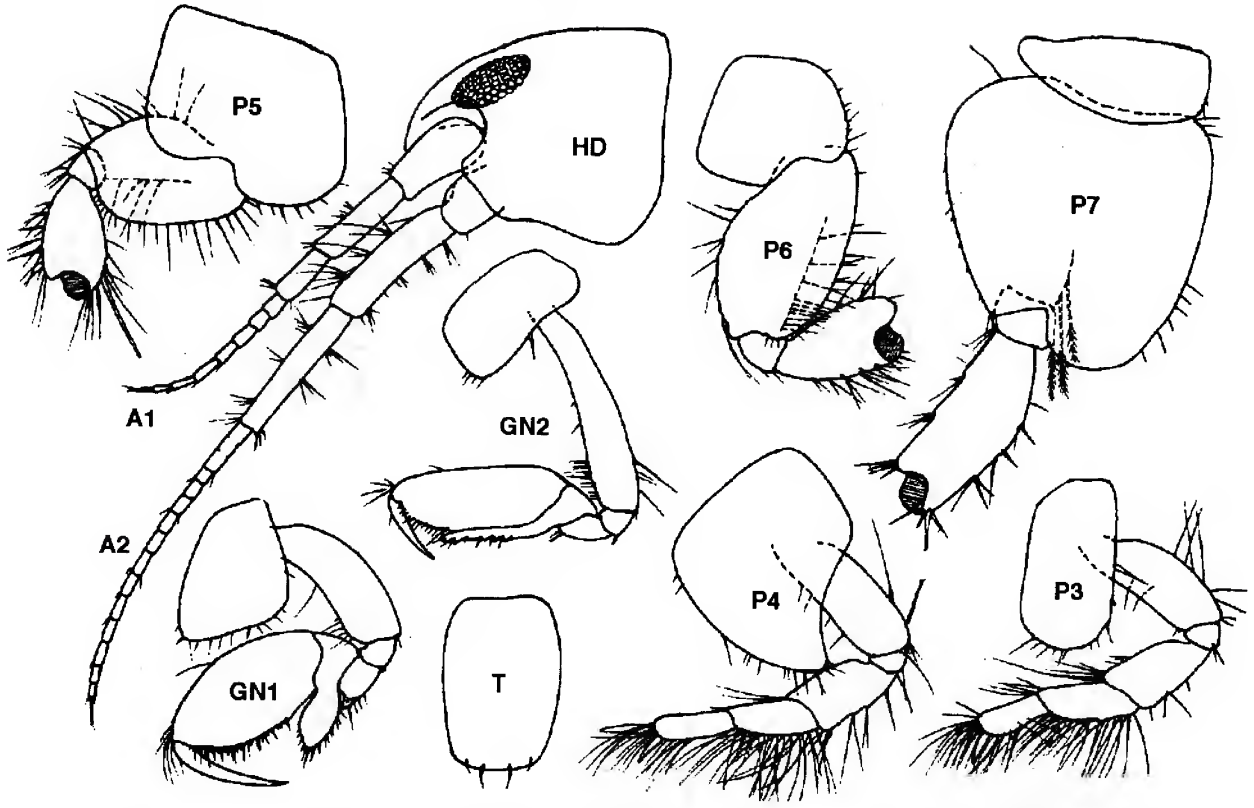

FIG. 17. ***Pacifoculodes barnardi,*** **new species. Off Pt. Conception, California. Female ? (4.5 mm). (after Barnard, 1962).**

Mouthparts undescribed.

Coxa 1 broadened distally, weakly setose below, hind margin with 1 slender spine. Coxa 2 subrectangular, hind margin with single spine. Gnathopod 1, merus with stout postero distal process; carpus short, deep, hind lobe large, rhomboidal, extending beyond palmar angle; propod elongate-ovate, palm strongly oblique, longer than hind margin. Gnathopod 2, basis weakly setose antero-distally; carpus short, hind lobe slender, slightly exceeding palm, lower distal margin with 5-6 small clusters of setae; propod slender, length ~3X maximum depth, little narrowing distally to medium oblique palm.

Coxa 4 greatly broadened distally, weakly setose below, hind process sharply rounded. Peraeopods 3 & 4, segment 4 very stout, not strongly setose; dactyls slender, length <1/2 segment 6. Coxa 5 medium deep, weakly posterolobate. Coxa 6 medium deep (length <basis), posterolobate. Peraeopod 6 larger than 5; segment 4 regularly broadening distally; distal segmented lacking, undescribed. Peraeopod 7, bases very broad proximally, hind margin convex, short-setose distally, posterodistal lobe very large, deep, exceeding ischium below.

Pleon plate 2, hind corner produced, acute. Telson subrectangular, lateral margins convex, hind margin slightly convex, with centre pair of slender spines and outer pair of short setae.

Etymology: The species is named in honour of the late J. L. (Jerry) Barnard who first described and figured the original material, and whose early studies on the North American Pacific Oedicerotidae provide a solid basis for the present undertaking.

Distributional ecology. Known only from two stations off Pt. Conception, California, in depths of 17-20 m.

Taxonomic commentary. Barnard (loc. cit.) compared his Californian material with the material of Mills (loc. cit.) from British Columbia. He noted differences in the pleon plates and in the ecological station of the two populations. These differences, combined with several other character state differences noted above and in the key (p.), are here considered sufficient for full species recognition of the Barnardian form.

Pacifoculodes bruneli, new species
(Fig. 18)

Monoculodes spinipes Mills, 1962 (part?).—Austin, 1985: 591.— Staude, 1987: 378.

Material Examined. About 200 specimens, including 20 females and 11 males from the following 15 locations:
ALASKA:
Prince William Sound Region: A140 (McLeod Harbor Beach) - 1 male, 1 female, 1 immature; A81 (Cordova Beach) - 1 male. Yakutat Inlet: A71 (Ankau Creek) - 1 immature.

Southeastern Alaska: A54 (Taylor Bay) - female (13.0 mm), **Holotype;** male (6.5 mm), **Allotype**, CMN cat. no. NMCC-1990-1181; A55 (Taylor Bay) - 1 male.
ELB Stns., Sitka region,1980: ~120 males, females, immatures at S4B1, S4B2, S11B3, S11F1, S11F3, S18F1, S18F2, S18F3.
Southern Alexander Archipelago: ELB Stn. A7 (Bostwick Inlet) - 1 male, 1 female.

Diagnosis. Female ov (13.0 mm): Head, rostrum regular, little deflexed distally. Eye medium, partially on base of rostrum. Lateral head lobe broadly rounded, oblique. Antennae (paratype) medium, regular; antenna 1 slightly longer than peduncle of antenna 2; peduncular segment 2 shorter than segment 1; segment 3, length about 1/2 segment 2 . Antenna 2, flagellum not longer than peduncle, 20-25 segmented.

Mandible, left lacinia 5-dentate; right lacinia irregularly bifid; spine row with 6-7 blades; palp stout, segment 3 shorter than segment 2. Maxilla 1, palp segment 2 with 8 disto-lateral marginal setae. Maxilliped, inner plate very short, apex rounded, with single slender spine and several setae; outer plate medium, with 6-7 distal outer marginal setae; palp segment 2 medium broad, distal margin oblique.

Coxa 1-4 increasing in size and depth posteriorly, lower margins strongly setose, hind margins with spines. Gnathopod 1, meral process strong; carpus narrow, hind lobe large, long, extending well beyond palmar angle; propod large, subovate, length ~1.5X depth; length of palm more than twice posterior margin. Gnathopod 2, carpus narrow, hind lobe very slender, slightly exceeding palm, lower margin with 15+clusters of setae; propod slender, narrowing distally to short oblique palm, length ~3X maximum depth, inner surface antero-distally with 4-5 clusters of setae.

Coxa 4 greatly broadened and produced distally. Peraeopods 3 & 4, segment 4 antero-distally very stout, setose; dactyls slender, short, length <1/3 segment 6. Coxa 5 very deep, aequilobate. Coxa 6, depth = length of basis, postero-lobate. Peraeopods 5 & 6 dissimilar; segment 4 regularly broadening distally; segment 6 weakly setose antero-distally; dactyls short, <1/2 length of segment 6, chitinous rings small. Peraeopod 7, bases very broad, hind margin strongly convex, postero-distal lobe deep, exceeding ischium.

Pleon plate 2, hind corner acuminate, slightly produced., pleon plate 3 broadly obtuse behind. Uropod 1, rami shorter than peducnle, outer ramus the shorter Uropods 2 & 3 rami subequal tips extending rearwards equidistant;margins with 6-8 short spines. Telson short-rectangular, hind margin truncate, with submedian pair of slender spines inside pair of minute setae.

Male (6.5 mm): Anterior head lobe more sharply rounded, eye distinctly larger than in female. Antenna 1, flagellum 10 segmented, basal segments callynophorate but not conjoint. Antenna 2, peduncular segments 4 & 5 relatively long, anterior margins with some longish bruch setae; flagellum not elongate.

Etymology: The species is named in honour of Dr. Pierre Brunel, Université de Montreal, Québec, an outstanding contributor to knowledge of benthic marine systematics and ecology, who has provided laboratory facilities, reference material, and helpful advice for the present study.

Distributional Ecology: Known only from exposed and semi-protected sand beaches of southeastern Alaska, in the region from Prince William Sound south to Cross Sound; an apprent ecological counterpart to the more southerly *M. spinipes* Mills.

Taxonomic commentary. *Pacifoculodes bruneli* might be considered a sibling species of *P. spinipes* Millls, so closely is it similar in morphology and life style. However, the character of the key (p. 104) apply consistently well to larger immatures and to mature males and females, confirming the separation of the two forms at species level.

A member of the *spinipes* group but differing mainly in the more steeply decurved rostral frontal margin; shorter carpal lobe of gnathopod 1; very slender propod of gnathopod 2, with distally protruding carpal lobe; bluntly upturned pleon 2 hind process, and distally broad telson with 4 marginal setae.

Pacifoculodes crassirostris (Hansen)?
(Figs. 19, 20)

Monoculodes crassirostris (Hansen) Gurjanova, 1951: 568, figs. 374B, 375.—Ledoyer, 1972: 769, figs. 1, 2, 3J, 3K.
non *Monoculodes crassirostris* Hansen, 1887: 108, figs. 5, 5f.—Gurjanova, 1951: 568, figs. 374B, 375.—Barnard & Karaman, 1991: 559.

Material Examined.
ALASKA:
Aleutian Islands. Unimak I., P. Slattery Stns.,1982: C28 - 1 female; C66- 1 female (11.5 mm) CMN cat. no. NMCC-19900447; C94 - 3 immatures; C112 - 1 immature; C113 - 1 immature. CMN collections, Ottawa.

Taxonomic commentary. Ledoyer (1972) first suggested that *M. crassirostris* Hansen, as figured and described from Russian far eastern waters by Gurjanova,1951, differed significantly from *M. crassirostris* Hansen, 1887, from northwestern European waters. Although material has not been examined here, Ledoyer's decision seems soundly based. We therefore take the liberty of rediagnosing the material of Gurjanova (loc. cit.), refigured by Ledoyer (loc. cit.), to accentuate differences from other members of the genus *Pacifoculodes.*

Diagnosis. Female (11.5 mm). Head, rostrum medium strong, slightly deflexed apically. Eye nearly fully basally on rostrum; anterior head lobe short, subacute. Antenna 1 short, barely extending beyond peduncle of antenna 2; peduncular

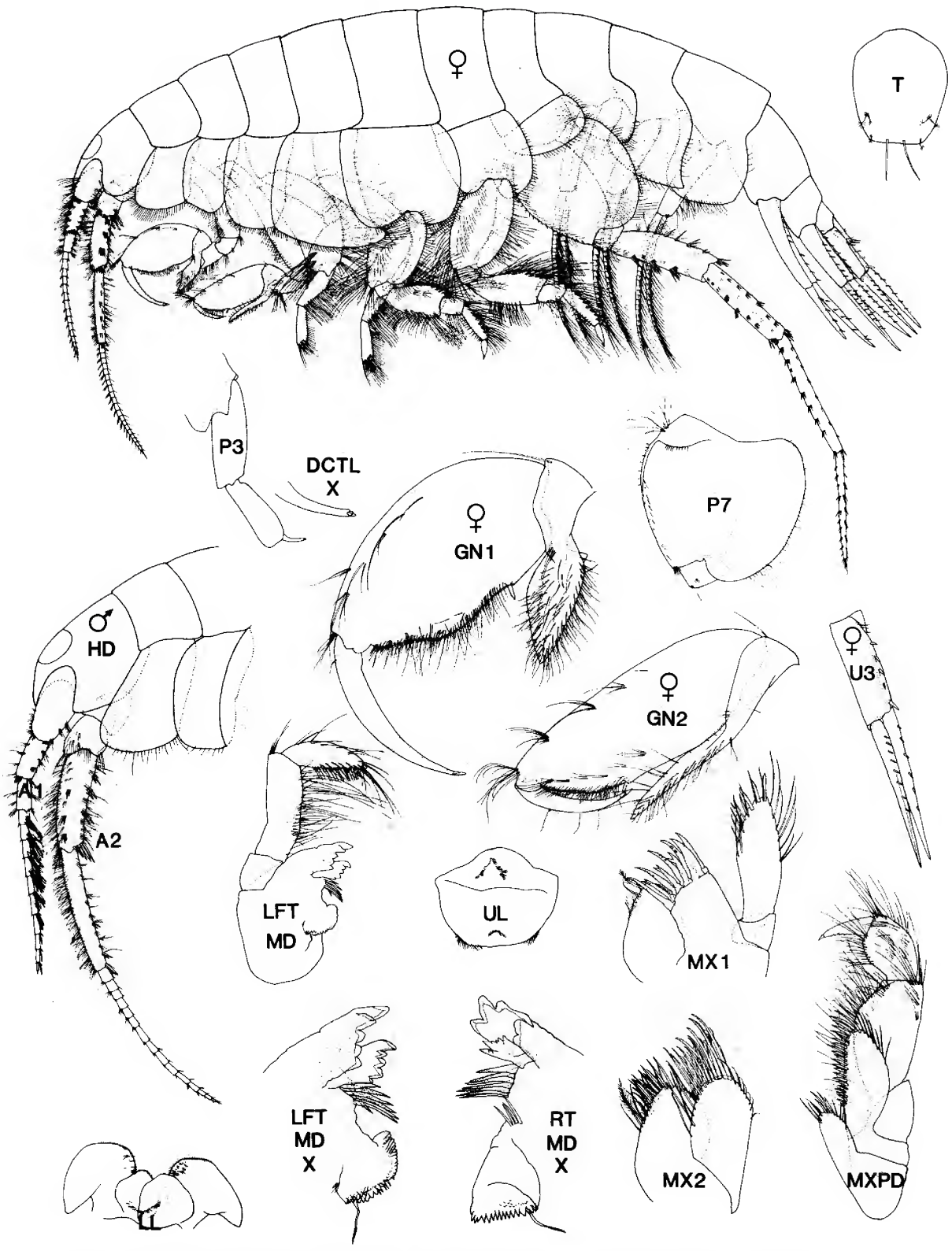

FIG. 18. *Pacifoculodes bruneli,* new species. Taylor Bay, Southeastern Alaska. Female (13.0 mm); male (6.5 mm).

segment 1 thick, heavily setose anteriorly; segment 2 subequal to 1 but much less setose; segment 3 short; flagellum ~12-segmented. Antenna 2, peduncular segment 5 >4, both strongly setose, flagellum<peduncle, ~ 30-segmented.

Mandible, spine row with 5-6 blades; palp segment 3 slender, spinose and setose; palp 3 much shorter, outer margin setose. Maxillae 1 & 2 not described. Maxilliped, inner plate, apex with single spine and several setae; outer plate

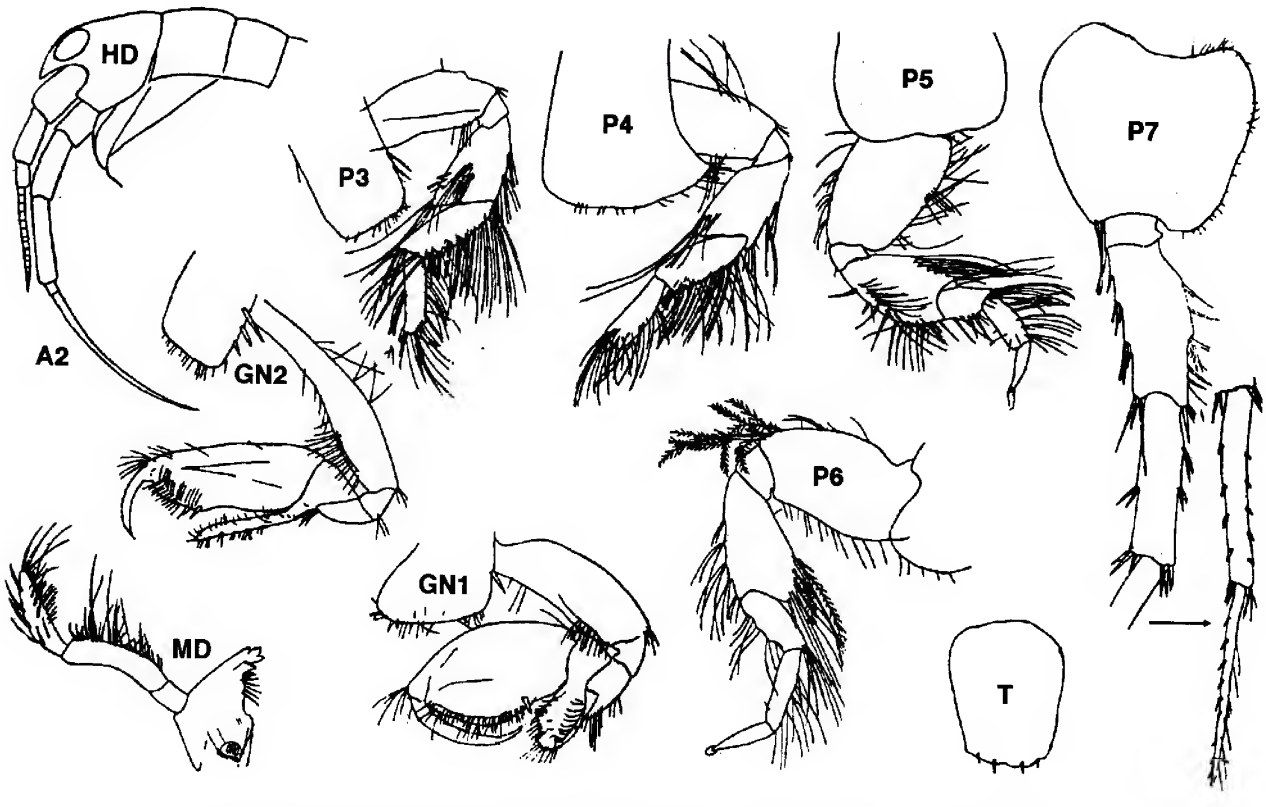

FIG. 19. ***Pacifoculodes crassirostris*** **(Hansen)? Japan Sea. Female (10.0 mm). (after Gurjanova, 1951).**

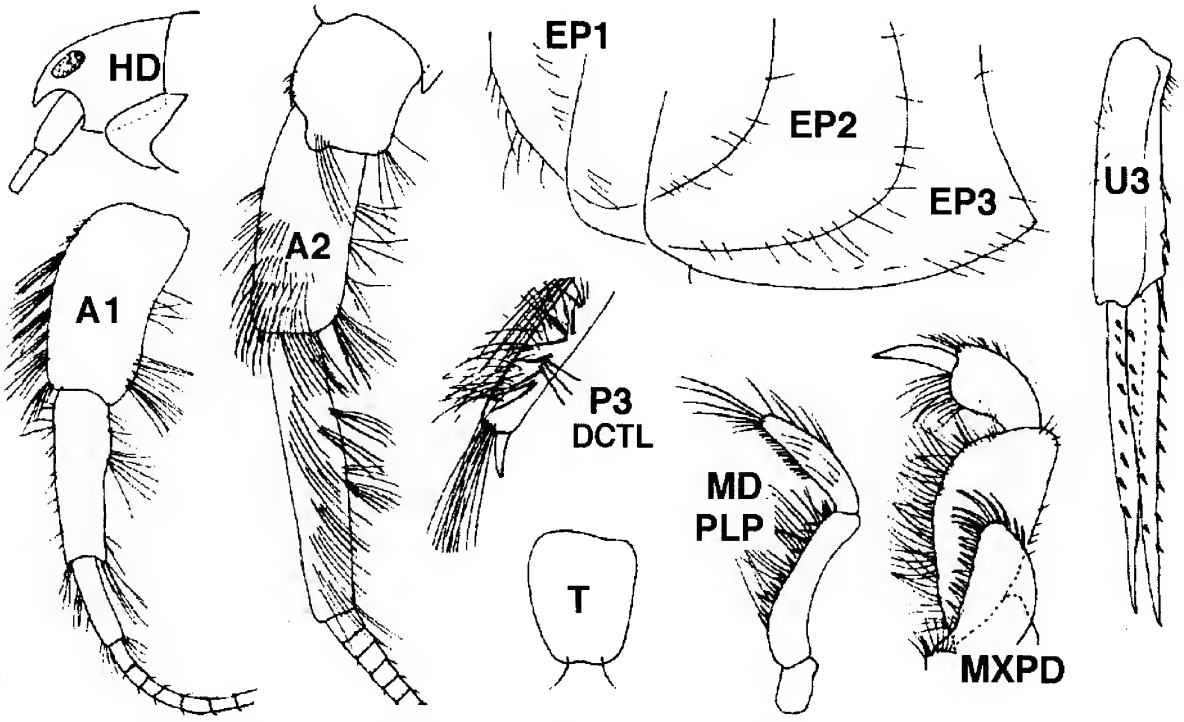

FIG. 20. ***Pacifoculodes crassirostris*** **(Hansen)?. Female (13.0 mm?). Sea of Japan. (after Ledoyer, 1972).**

medium broad; palp segment 2 broad, distal margin oblique.

Coxae 1 & 2, hind margins with 2-5 slender spines respectively. Gnathopod 1, merus with strong posterior process; carpus narrow, hind lobe broad, diamond-shaped, apex exceeding palmar angle; propod stout, long-ovate; posterior margin short,< 1/2 strongly oblique palmar margin. Gnathopod 2, carpus narrow, hind lobe slender, weakly setose, apex exceeding palmar angle; propod, length 2.5 X greatest width, narrowing slightly distally to oblique palm.

Coxa 4 not strongly broadened distally, hind process acute. Peraeopods 3 & 4 strongly fossorial, setose; segment 5 >>6 and strongly setose behind; dactyls very short . Coxa 5 medium, aequilobate; segment 4 strongly broadening distally; segment 5 short; segment 6 weakly or not setose anteriorly; dactyls medium, length 2/3 segment 6. Peraeopod 7, basis, hind margin broadly rounding proximally, nearly straight distally, hind lobe medium deep (not exceeding ishium), broadly rounding.

Pleon plate 2, hind corner subacute, little produced. plate 3 broadly obtuse. Uropod 1, rami <peduncle, outer ramus marginally bare. Uropod 2 & 3, rami >respective peduncles, with numerous marginal spines. Telson small, narrowing to nearly straight apical margin bearing 2 medium and 2 short setae.

Distributional commentary. Known from the northwestern Pacific, including Bering Strait and northeastern Atlantic, subtidally at shelf depths.

Taxonomic commentary. As Ledoyer detailed, material from the Bering Sea region is distinct from Hansen's species. Although in agreement with Ledoyer's conclusions, we prefer that this species be formally named by a further revisor who examines all pertinent materials.

Pacifoculodes levingsi, new species
(Fig. 21)

Material Examined.
BRITISH COLUMBIA:
North-central coast, C. Levings Stns., Swanson Bay, 1975: Stn. J - 1 female ov. (6.0 mm), **Holotype** (slide mount), CMN Cat no. NMCC1990-464, Ibid, 2 imm, **Paratypes**; Stn JC - 1 female, 1 male; Stn M - 1 female, 2 im (1 with head only)

Diagnosis. Female ov. (6.0 mm): Head, rostrum regular, little deflexed distally. Eye medium, partially on base of rostrum. Lateral head lobe oblique, upper angle squared. Antennae (paratype) medium, regular; antenna 1 longer than peduncle of 2; peduncular segments 2 & 3 relatively short. Antenna 2, flagellum not longer than peduncle.

Mandible, left lacinia irregularly 7-dentate; right lacinia bifid; spine row with 5-6 blades; palp segment 3 slender, length <segment 2. Maxilla 1, palp segment 2 sparsely setose. Maxilliped, inner plate very short; outer plate with 4-5 outer distal setae; palp segment 2 medium broad.

Coxa 1 & 2 strongly setose below, hind margin each with 2 spines. Gnathopod 1, carpus longer than deep, hind lobe large, long, extending beyond palmar angle; propod subrectangular, relatively long, length ~2X depth; palm shorter than posterior margin. Gnathopod 2, carpus shorter than deep, hind lobe very slender, slightly exceeding palm, lower margin with 8-10 clusters of setae; propod slender, narrowing distally to short oblique palm , length 4-5X maximum depth inter surface antero-distally with 5-6 clusters of setae.

Coxa 4 greatly broadened distally, setose below. Peraeopods 3 & 4, segment 4 very stout, setose; dactyls slender, length ~ 1/2 segment 6. Coxa 5 aequilobate, medium deep. Coxa 6 medium, deep, posterolobate. Peraeopods 5 & 6 unequal in size; segment 4 regularly broadening distally; segment 6 weakly setose antero-distally; dactyls ~2/3 length of segment 6. Peraeopod 7, bases very broad, hind margin convex, postero distal lobe shallow.

Pleon plate 2, hind corner squarish, pleon plate 2, broadly obtuse behind. Uropods 1-3 rami subequal, weakly marginally spinose. Telson short-rectangular, hind margin irregularly shallow-convex, with centre pair of slender spines inside of pair of short setae.

Coxal gills relatively short, rounded below. Brood plates short, apically with 9-10 simple setae.
Male (4.5 mm). Single specimens subadult, little differing from female.

Etymology: The species is named in honour of Dr. Colin R. Levings, Pacific Environmental Institute, who collected the type specimen, and whose biological survey work has added greatly to knowledge of the marine fauna of the northeastern Pacific coastal region.

Distributional Ecology. Known only from the type locality at Swanson Bay, B. C., in silty mud, at 30-45 m.

Taxonomic Commentary: Although the type specimen lacks antennae and distal portions of peraeopods, the taxonomic features of the mouthparts, coxal plates and peraeopods, are unlike those of other known species of the genus (see key, p. 104).

Pacifoculodes zernovi (Gurjanova)
(Figs. 22, 23)

Monoculodes zernovi Gurjanova, 1936: 374A, figs, 23, 23A.—Gurjanova, 1951: 566, figs. 373, 374A.—Mills, 1962: 9, fig. 2.—Austin, 1985: 591.—Staude, 1987: 378, fig. 18.68.—Barnard & Karaman, 1991: 560.

Material Examined. Approximately 100 specimens in in 21 lots, from the Seward Peninsula and the Bering Sea, southward to the south end of Vancouver Island, as follows:
ALASKA:
Bering Sea region. C. E. O'Clair, Stn., Constantine Harbor, 1969 - 1 immature. P. Slattery Stns., 1983: St. Matthew I., - 2 specimens; Walrus Cove - 27 specimens.

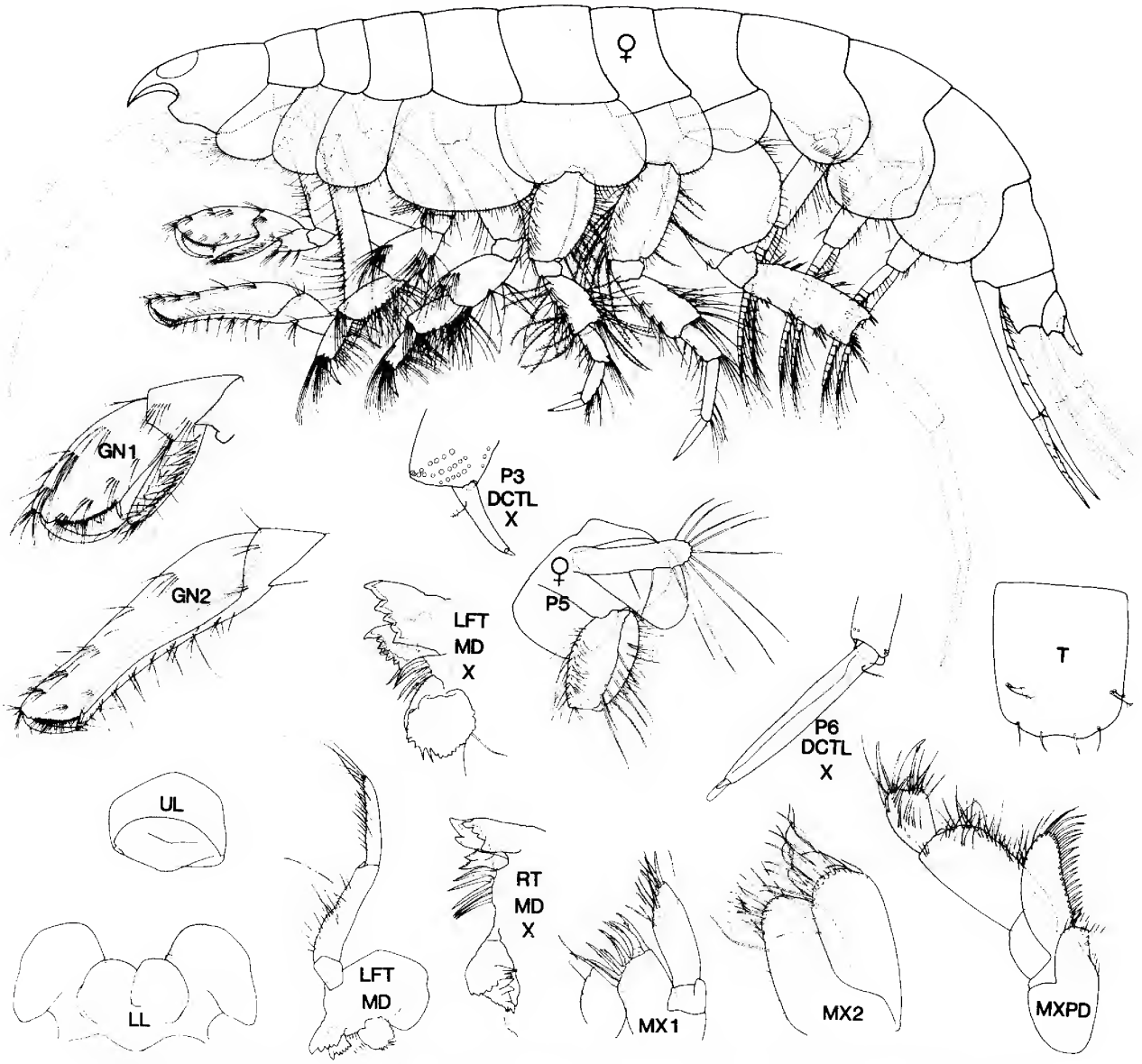

FIG. 21. ***Pacifoculodes levingsi,*** **new species. Swanson Bay, B. C. Female (6.0 mm).**

Mainland coast, 1981: Cape Nome - 18 specimens; Cape Rodney - 1 female, 3 immatures.
Southeastern Alaska. ELB Stn. A135 (Resurrection Bay). glacial mud, 24 m. - 1 immature.

BRITISH COLUMBIA:
Queen Charlotte Islands. ELB Stn. E14e (Gillat I.), July, 1957 - 14 immatures.
North-central coast. ELB Stns., July, 1964: 4 specimens at H17, H21, H34, H36.
South-central mainland coast. ELB Stn. E3 (off Dollarton), coarse sand, woody detritus, 16-20 m., Nov. 4, 1977 - 2 specimens.
Vancouver Island. ELB Stn. P26 (Koprino Harbour), mud, shell, 12-16 m., Aug. 14, 1975 - 11 immatures; ELB Stn. B1 (Departure Bay, off Hammond Beach), sandy mud, 5-17 m., May 14, 1977 - 3 immatures; B6b (Trial Island), LW level-1 immature.
G. W. O'Connell Stn. W153b (Victoria, off Clover Pt.), Aug., 1976 - 2 immature females (to 8.0 mm).

Diagnosis. Female ov. (11.0 mm): Head deeply incised below very large nearly straight rostrum, anterior head lobe short, acute. Eye large, centrally on rostrum. Antenna 1, peduncular segments 1 & 2 slender, subequal, 3 short; flagellum 15-20 segmented, distally weakly setose, slightly exceeding pedunc le of antenna 2. Antenna 2, peduncular segment 4 setose, stronger and longer than 5; flagellum elongate, flagellum ~40-segmented, longer than peduncle.

Lower lip broad, inner lobes distinct. Mandible, left lacinia irregularly 5-dentate; right lacinia bifid; spine row with 5-6 blades; palp segment 3 very slender, length slightly less than segment 2. Maxilla 1, palp segment 2, outer margin distally setose. Maxilliped, inner plate very short, apex setose; outer plate tall slender, with 4-5 outer distal setae; palp segment 2 broad, distal margin oblique; dactyl curved.

Coxa 1 broadened distally, strongly setose below, hind margin bare. Coxa 2 strongly setose below, hind margin with

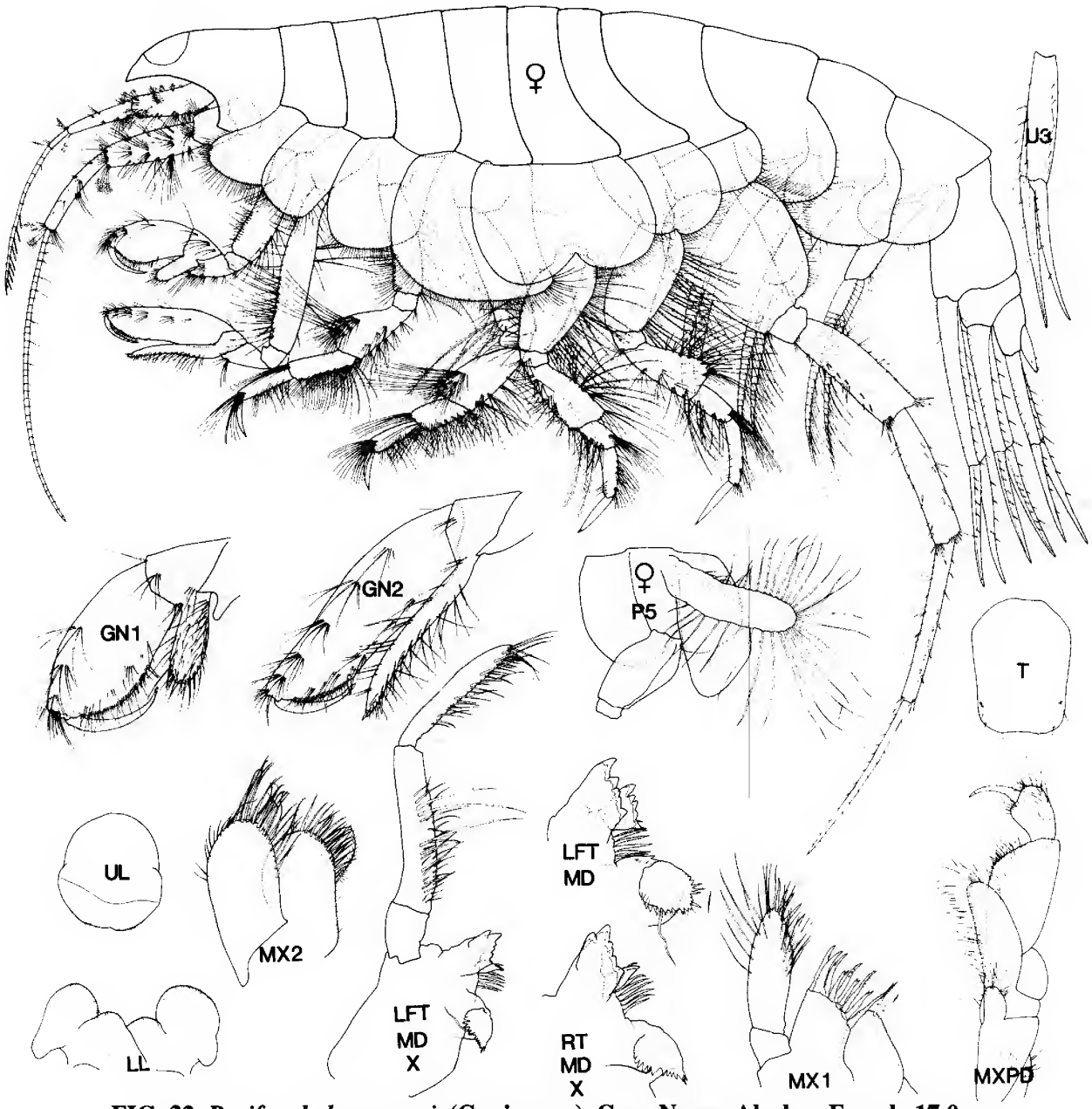

FIG. 22. ***Pacifoculodes zernovi*** **(Gurjanova) Cape Nome, Alaska. Female 17.0 mm.**

3-4 short spines. Gnathopod 1, meral hind process strong; carpus longer than deep, hind lobe broad, extending slightly beyond palmar angle; propod subrectangular, relatively long, length about twice maximum depth; palm strongly oblique, length ~posterior margin. Gnathopod 2, basis strongly setose antero-distally; carpus shorter than deep, posterior lobe very slender, not closely approximating hind margin of propod , apex slightly exceeding palm, lower margin strongly setose; propod slender, narrowing distally to short oblique palm, length 3-4X maximum depth, inner surface anterodistally with 5 clusters of setae.

Coxa 4 broadened distally, setose below, hind process sharply rounded. Peraeopods 3 & 4, segment 4 very stout distally and strongly setose; segment 5 slightly longer than 6, strongly setose below; dactyls slender, length ~2/3 segment 6. Coxa 5 deep, broad, aequilobate. Coxa 6 relatively broad, weakly posterolobate. Peraeopods 5 & 6 unequal in size; segment 4 regularly broadening distally; segment 6 weakly setose antero-distally; dactyls stout, length ~segment 6. Peraeopod 7, bases regularly broad, hind margin convex, postero distal lobe shallow, broadly rounded.

Pleon plate 2, hind corner squarish, that of pleon plate 3 broadly obtuse. Uropods 1-3, rami slender, weakly marginally spined, extending subequally. Telson subrectangular, hind margin subtruncate, with centre pair of slender spines flanked by pair of short setae.

Coxal gills regular, subrectangular. Brood plates relatively large, broad, margins and apex strongly setose.

Mature male unknown.

Distributional ecology. Widely distributed along open sandy beaches, from the Bering Sea to southeastern Alaska, and south-ward to southern British Columbia subtidally to depths of 40 m.

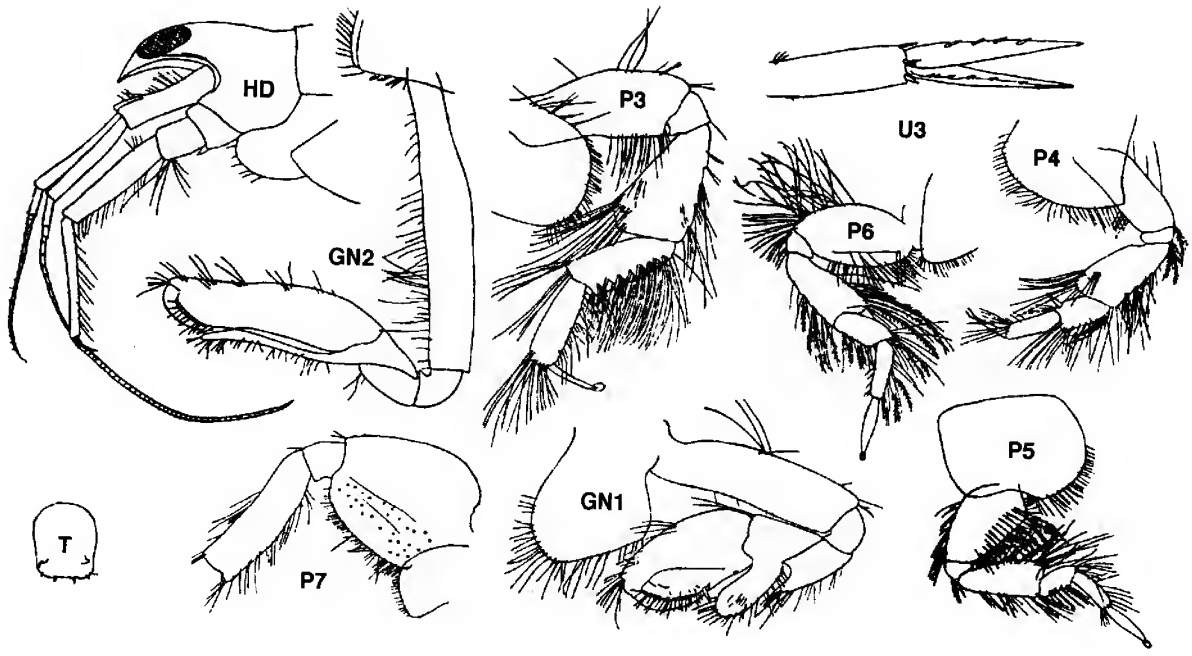

FIG. 23. *Pacifoculodes zernovi* (Gurjanova). Japan & Okhotsk Seas. Female (15.0 mm). (after Gurjanova, 1951).

Taxonomic commentary. As noted below (p.140), *P. zernovi* is strikingly unlike other North American Pacific species, with closest similarity to the Asiatic *P. nasutus* (Bulycheva). The North American Pacific material from the Bering sea region compares very closely with that from the Sea of Japan, described and illustrated by Gurjanova (1951). However, the more southerly North American specimens are slightly smaller at maturity, the coxa of peraeopod 5 appears somewhat broader, and peraeopod dactyls are slightly shorter.

Western Pacific Species of *Pacifoculodes*

Several species of *Monoculodes* (sens. lat.) were initially described with little or no reference to the mouthparts, uropods, or degree of sexual dimorphism. These species are assigned (below) to the genus *Pacifoculodes* on features of the head, gnathopods, peraeopods, and telson.

Pacifoculodes synophthalmus (Bulycheva)

Monoculodes synophthalmus Bulycheva, 1952: 209, fig. 11.—Barnard & Karaman, 1991: 560.

Taxonomic and distributional commentary. *Pacifoculatus synophthalmus* is a medium large western Pacific surf zone ecological counterpart to *P. spinipes* and/or *P. bruneli.* It is distinctive in the very acute postero-distal lobe of the basis of peraeopod 7.

Pacificulodes dembiensis (Bulycheva)
(Fig. 24)

Monoculodes dembiensis Bulycheva, 1952: 214, fig. 15. — Barnard & Karaman, 1991: 559.

Taxonomic and distributional commentary. *P. dembiensis* occurs subtidally to depths of 6 m, from the Sea of Japan to the southern Kamchatka peninsula. This large (females to 18 mm), powerfully fossorial species is very distinctive in its large and powerful propod of gnathopod 1, very broadly expanded segment 4 of peraeopods 5 & 6, very wide basis of peraeopod 7, and extremely short, almost minute dactyls of peraeopods 3 & 4.

Pacifoculodes nasutus (Bulycheva)
(Fig. 25)

Monoculodes nasutus Bulycheva, 1952: 211, fig. 13.— Barnard & Karaman, 1991: 560.

Taxonomic and distributional commentary: This medium-sized species (female to 11.0 mm) has been recorded subtidally in depths of 70 - 351 m in the northern Sea of Japan. Its long slender rostrum, small broad coxa 1, very wide basis of peraeopod 7, and slightly emarginate telson are distinctive features.

Pacifoculodes breviops (Bulycheva)

Monoculodes breviops Bulycheva, 1952: 213, fig. 14.— Barnard & Karaman, 1991: 559.

Taxonomic and distributional commentary. *P. breviops* is a small species (female 5-6 mm) that been taken subtidally to depths of 55 m in the northern part of the Sea of Japan. It is distinguished by the small eye located distally on the apically deflexed rostrum, the small broadly rounded coxal plate 1, and very elongate propod and narrow palm of gnathopod 2.

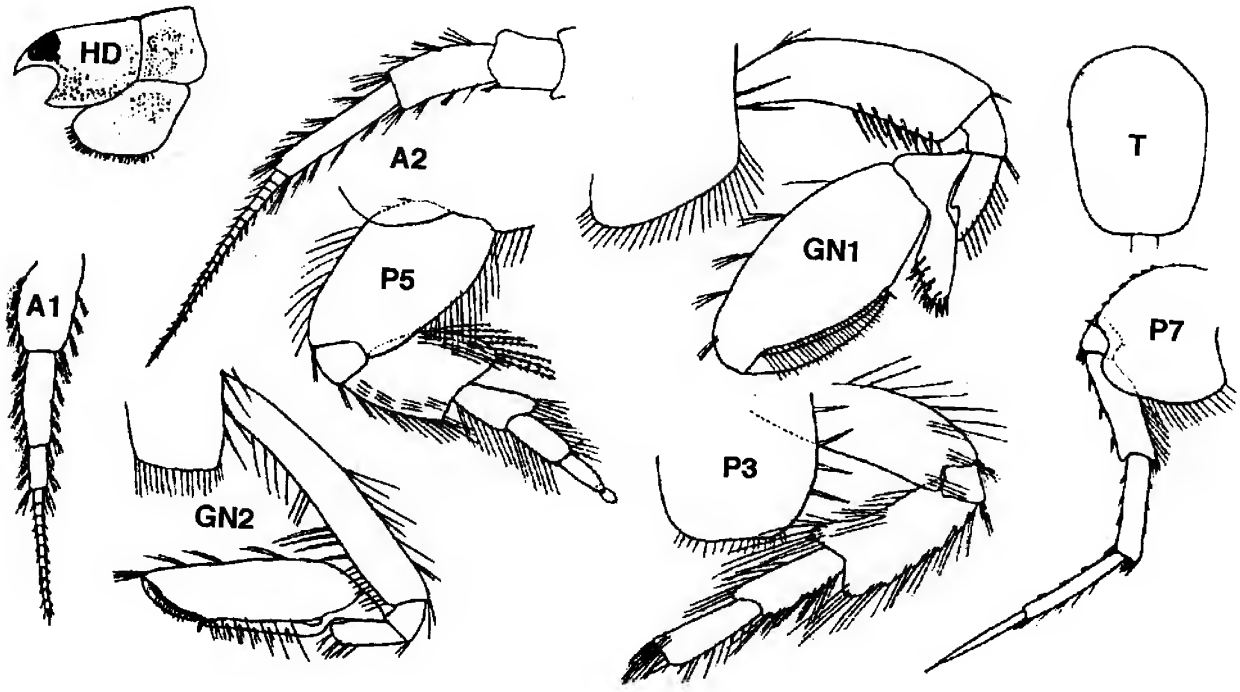

FIG. 24. ***Pacifoculodes dembiensis*** **(Bulycheva). Japan Sea, Kamchatka. Female (6 - 7 mm). (after Bulycheva, 1952)**

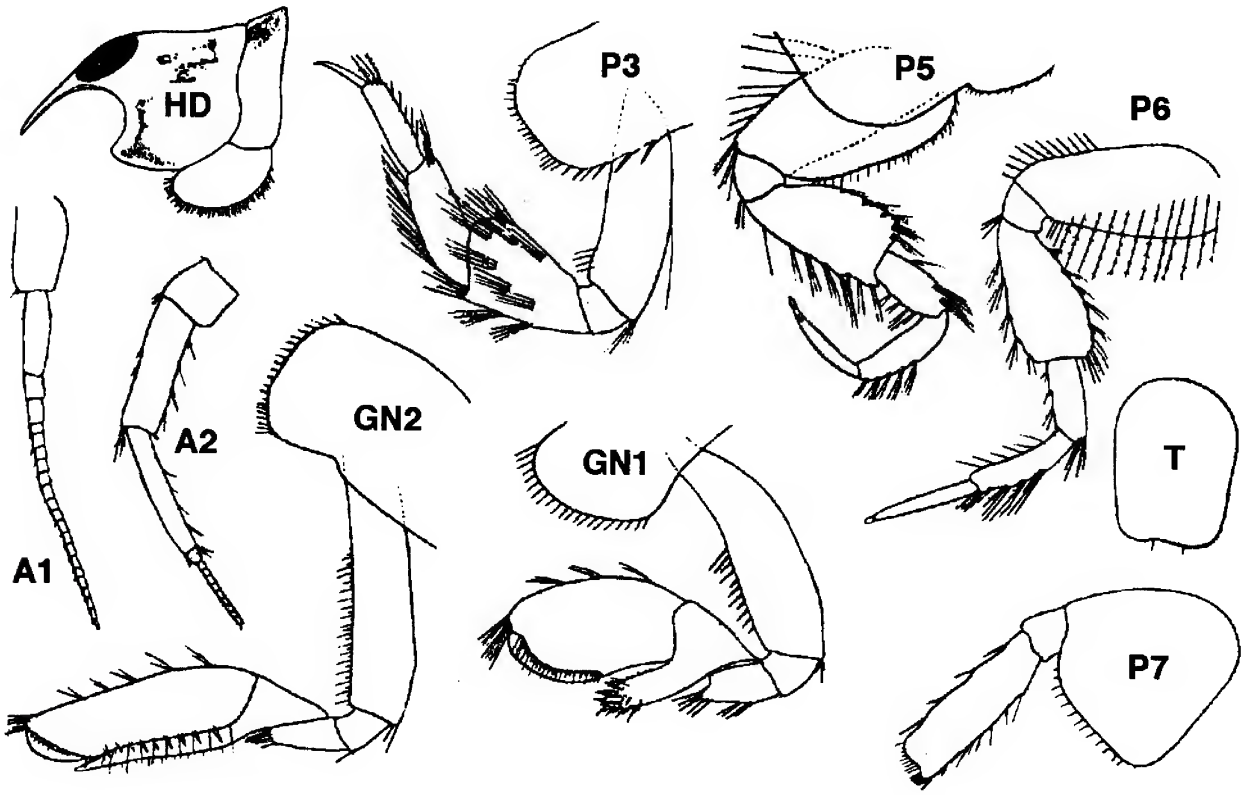

FIG. 25. ***Pacifoculodes nasutus*** **Bulycheva. Japan Sea, to 150 m. Female (11.0 mm). (after Bulycheva, 1952).**

Limnoculodes, new genus

Monoculodes Stimpson (part).—Tattersall, 1922: 440.—Nagata, 1965: 169.—Morino, 1990: 14.—Barnard & Karaman, 1991: 559.—Ishimaru, 1994: 71.

Type species. *Monoculodes limnophilus* Tattersall, 1922: 440, present selection.

Species: *Limnoculodes japonicus* (Nagata, 1965).

Diagnosis. A primitive but distinctive genus. Head, rostrum deflexed apically. Eyes fully on rostrum, sexually dimorphic. Antennae short, sexually dimorphic. Antenna 1 short, segments 2 & 3 very short; flagellar segments callynophorate in male. Antenna 2, peduncular segments 4 & 5 with anterior marginal brush setae in male.

Lower lip, inner lobes medium. Mandible, molar triturative; left lacinia 5-dentate, right lacinia toothed; palp weak, segment 2 medium. Maxilla 1, inner plate triangular, with 1 apical seta; outer plate with 9 apical spines; palp slender, segment 1 long. Maxilla 2, inner plate small, weakly setose. Maxilliped, inner plate reduced, apex truncate, with 3 strong setae; outer plate with stout inner marginal teeth; palp 2 stout, broadening distally, segment 3 & dactyl short.

Coxa 1 moderately broadened distally, lower margin convex. Gnathopod 1 larger than gnathopd 2; propod elongate-ovate, palm long, oblique, convex; carpal lobe medium Gnathopod 2, basis not setose anteriorly; carpus short, lobe medium,reaching palmar angle; propod relatively short,length 2.5 X maximum depth.

Coxa 3 normal, coxa 4 deep, broad. Peraeopods 3 & 4, segment 4 moderately fossorial; segment 5 slightly longer than segment 6; dactyls medium, chitinous rings minute.

Coxa 5 deep, broad, slightly postero-lobate. Coxa 6 broad, deep. Peraeopods 5 & 6, bases dissimilar; segment 4 not strongly fossorial; segment 5 shorter than 6; dactyls medium strong, thick, chitinous rings minute. Peraeopod 7, basis relatively narrow, with lower hind lobe; segments 6, anterior margin bare; dactyl thick, shorter than segment 6.

Pleon plates 2 & 4, broadly obtuse and/or rounded behind. Uropods 1, 2,& 3, outer ramus distinctly the shorter. Telson short, apex truncate,with 2 apical setae.

Coxal gills sac-like, elongate, rounded distally. Brood plates very slender, strap-like, margins setose distally.

Taxonomic commentary. Formal recognitionof monotypic, or near-monotypic, genera is justified when several taxonomic features are distinct or unique . In *Limnoculodes,* the very short antenna 1, structure of the mouthparts,the large propod of gnathopod 1 and small propod of gnathopod 2, and acutely lobate basis of peraeopod 7, are features unlike all other genera.

Limnoculodes appears least remote fromgenus *Monoculodes* sens. str. but shares some features with the N. American mesohaline genus *Ameroculodes.*

Limnoculodes limnophilus Tattersall
(Fig. 26)

Monoculodes limnophilus Tattersall, 1922: 440, Pl. 18, figs.10-20.—Morino, 1990: 14, figs 5-8.—Barnard & Karaman, 1991: 560. Ishimaru, 1994: .

Taxonomic commentary. This species is unique. Nagata (1965) described a brackish water form from Japan as *Monoculodes limnophilus japonicus.* However, in redescribing Tattersall's species, Morino (1990) recommended that the differences noted by Nagata (loc. cit.) between the Japanese form and Tattersall's original species, should be recognized at specific rank. These differences do not transcends the generic limits of *Limnoculodes* established above.

Monoculopsis G. O. Sars

Monoculopsis G. O. Sars, 1895: 310.—Stebbing, 1906: 257.—Gurjanova, 1951: 560.—Barnard & Karaman, 1991: 560.

Type species. *Monoculodes longicornis* Boeck 1871, by monotypy.

Species. *Monoculopsis vallentini* Stebbing, 1914: 360.

Diagnosis: Body smooth. Rostrum short, regular. Pigmented eyes basal. Antennae weakly sexually dimorphic. Antenna 1 longer than antenna 2 (adult), not callynophorate in male; peduncular segment 3, length = segments 1, 2.

Lower lip, inner lobes separate. Mandible, molar triturative; spine row with 4 blades; left lacine 5-dentate; right lacinia flabellate; incisor strongly toothed; palp regularly 3-segmented, segment 3 shorter than 2. Maxilla 1, inner plate with 2 apical setae; outer plate with 8-9 apical spines; palp regularly 2-segmented. Maxilla 2, plates small, regular, inner plate lacking facial setae. Maxilliped, inner plate with apical setae; outer plate medium, margins convex, apex rounded; palp segment 2 stout; dactyl strong.

Coxa 1 broadened distally. Coxa 4 broad. Gnathopods 1 & 2 strongly subchelate, propods dissimilar in form and size, narrowing distally, palms short, oblique; carpus, anterior margin distinct, hind lobe elongate, guarding propod below.

Peraeopods 3-4 strongly fossorial; segment 5 longer than 6; dactyls short. Coxae 5 broad, deep, anterolobate. Coxa 6 postero-lobate. Peraeopods 5 & 6 somewhat unequal, bases dissimilar; segment 5 short; dactyls medium. Peraeopod 7, basis broad, postero-dstal lobe distinct; dactyl elongate.

Pleon plate 2 subquadrate; pleon plate 3 rounded behind. Uropods 1-3 regular; rami regularly lanceolate, outer ramus slightly the shorter.

Telson short, narrowing distally, apex subtruncate.

Coxal gills and brood plates undescribed.

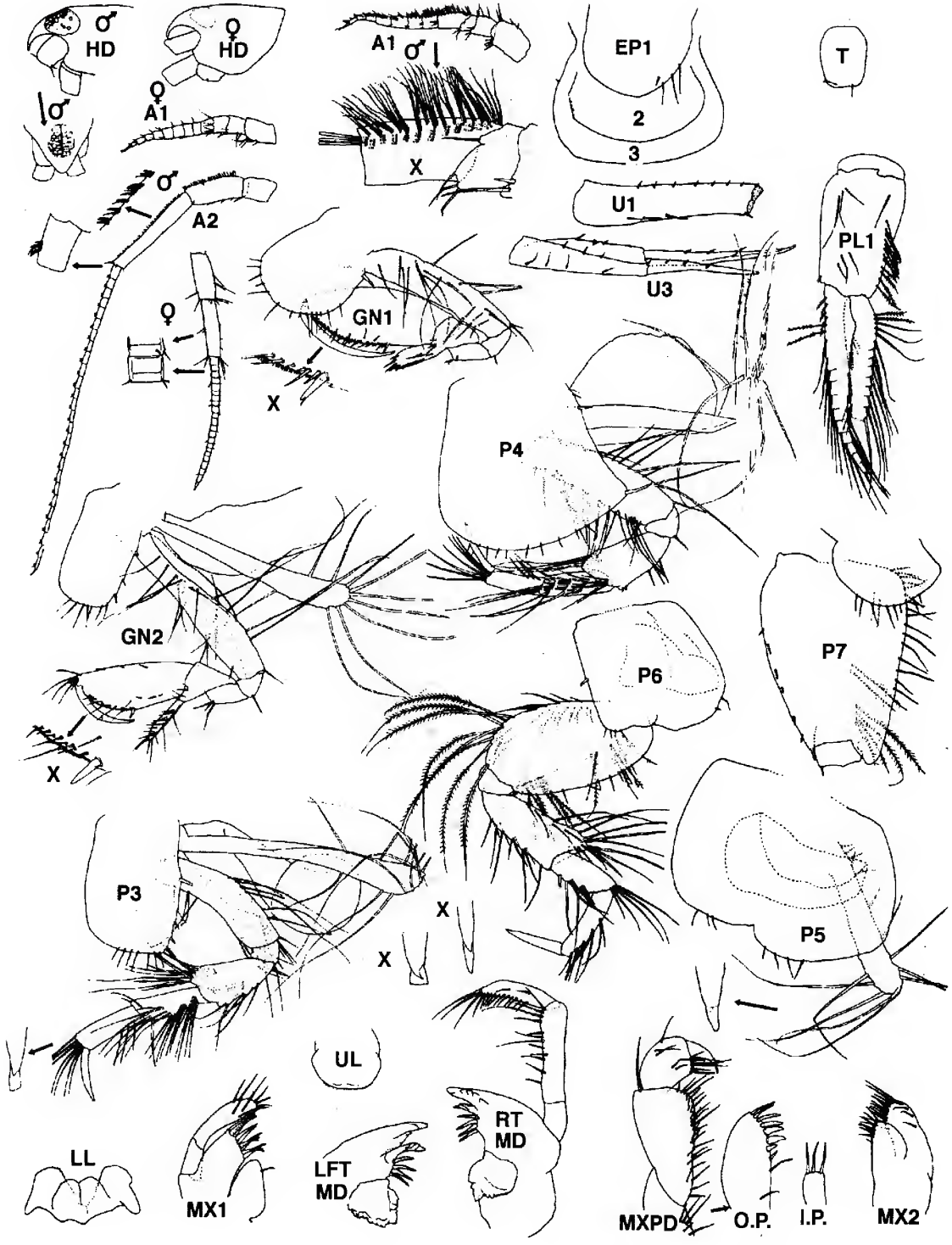

FIG. 26. *Limnoculodes limnophilus* Tattersall. Western North Pacific. Male (5.0+ mm); female (5.0 mm) (after Morino, 1990).

Taxonomic commentary: *Monoculopsis* is a member of the *Monoculodes* group of oedicerotids, having a strongly triturative mandibular molar, and elongate carpi of gnathopods 1 & 2 that guard the propods posteriorly. The genus differs from *Monoculodes* sens. str. mainly in the elongate peduncular segment 3 of antenna 1, distally narrowing propod of gnathopod 1, relatively elongate segment 5 of peraeopods 3 & 4, and shorter mandibular palp.

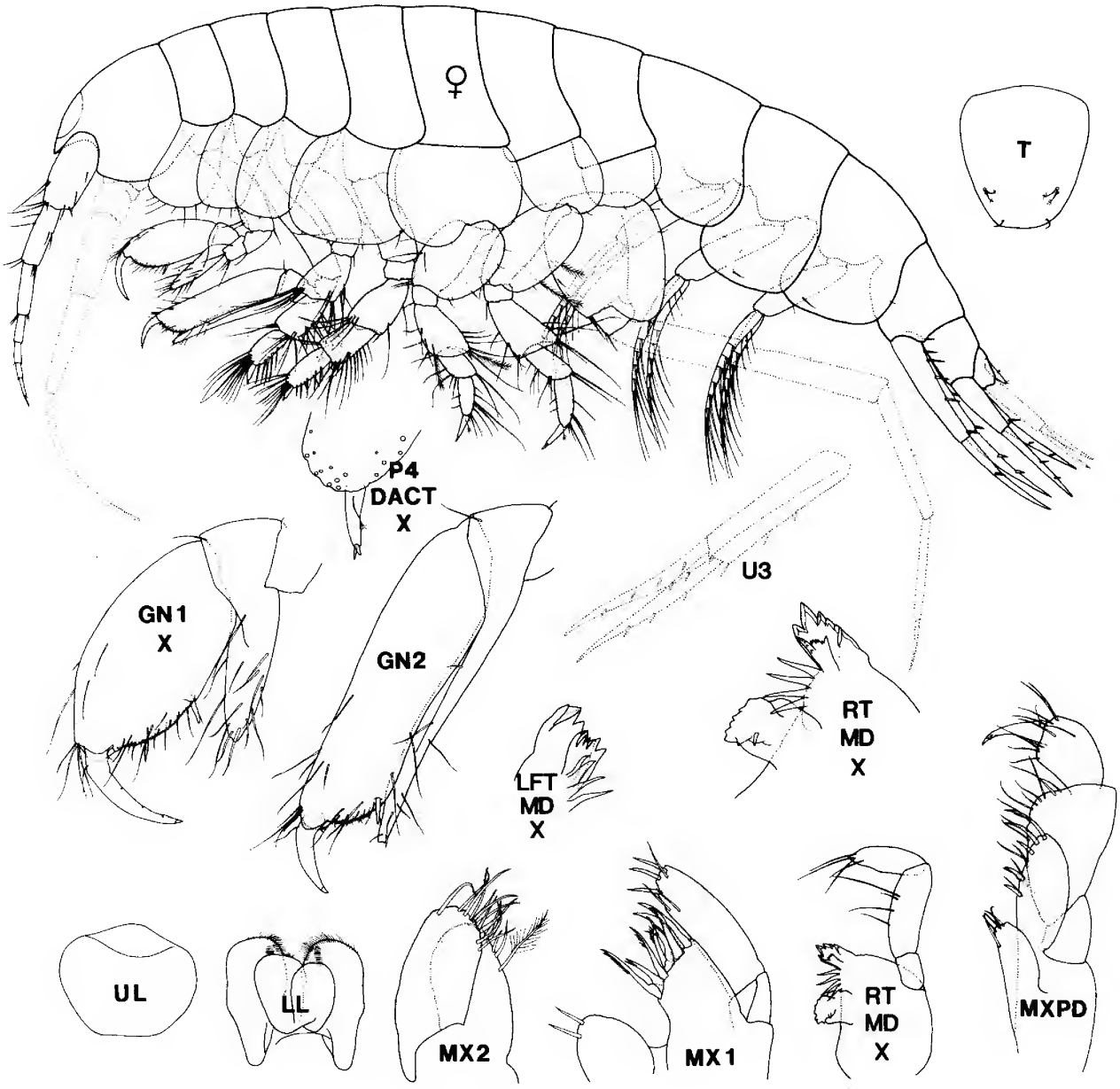

FIG. 27. *Monoculopsis longicornis* (Boeck). Walrus Cove, Alaska. Female subadult (3.5 mm).

Monoculopsis longicornis (Boeck)
(Figs. 27, 28)

Monoculodes longicornis Boeck, 1871b: 165.
Monoculopsis longicornis Sars, 1895: 311, pl. 110, fig. 1.—Stebbing, 1906: 258.—Gurjanova, 1951: 560, figs. 371A,B—Barnard & Karaman, 1991: 560.

Material examined.
ALASKA:
Mainland coast. Walrus Cove, P. Slattery coll.,1983 - 1 female subadult (3.5 mm) (**fig'd specimen**), CMN cat. no. NMC-1990-438; Ibid - 1 immature specimen, CMN cat. no. NMCC1991-323; Cape Nome, P. Slattery Stn., 1981 - 1 female subadult, NMCC1990-1543.

Diagnosis. Female (to 10.0 mm) (based on illustrations and descriptive commentary of Sars (1895), Gurjanova (1951), and Barnard & Karaman (1991), supplemented by subadult material examined (above): Antennal peduncles strongly setose.

Maxilla 1, outer plate with 8-9 apical spines.

Coxae 1 & 2, lower margins strongly setose, hind margins with 2-3 stout spines.

Gnathopods 2, propod distinctly narrowing distally; palmar margin short, finely serrulate, palmar angle with single stout spine; dactyl exceeding palm; carpal lobe narrowing to acute apex.

Peraeopods 3-6, segment 5 shorter than 4 & 6; dactyls medium to strong, chitinous rings minute. Peraeopod 7, dactyl subequal in length to segment 6.

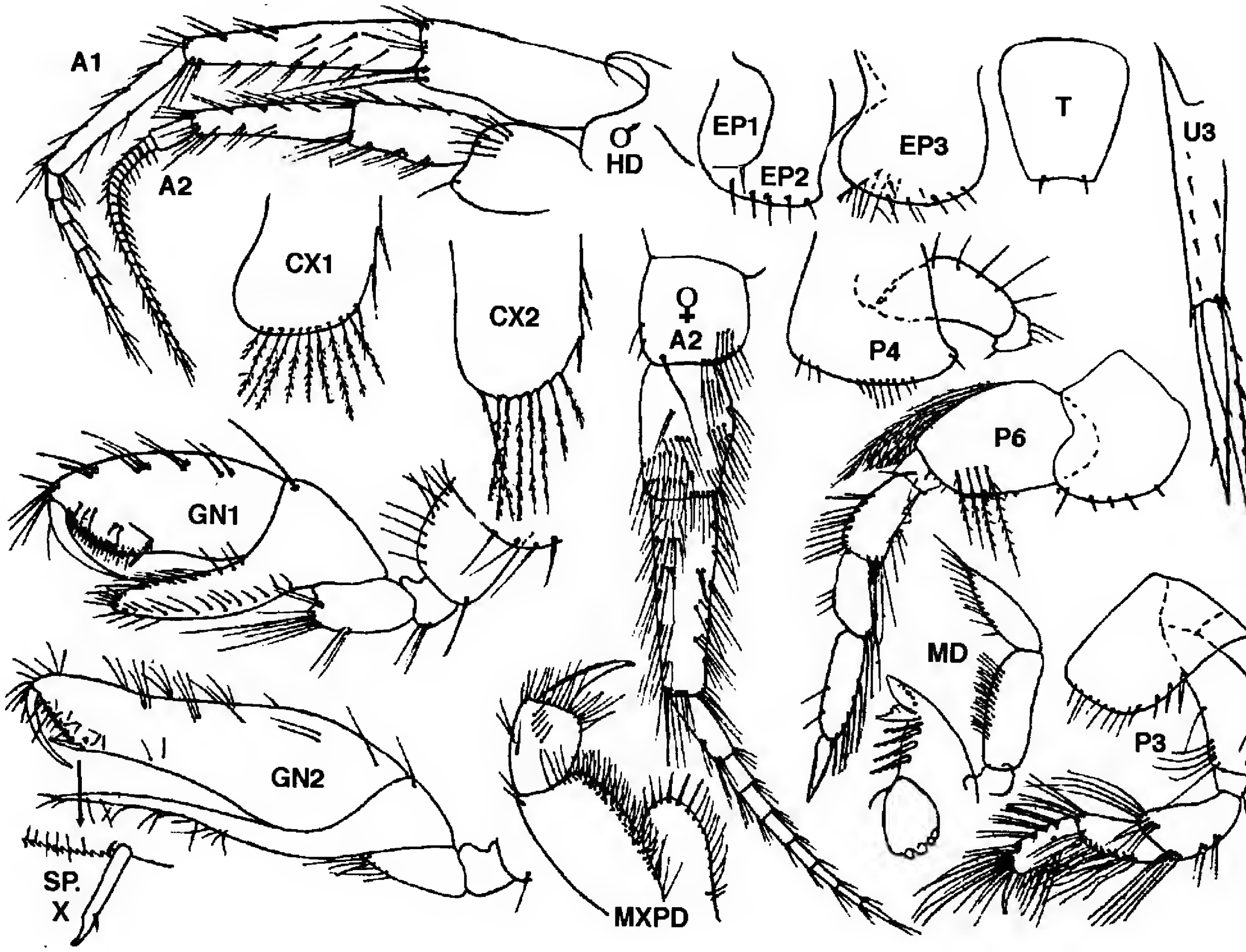

FIG. 28. ***Monoculopsis longicornis*** **Boeck. Kara Sea. Male (10.0 mm); female (10.0 mm). (after Gurjanova, 1951).**

Telson short, apical margin may be slightly indented, with 2 widely spaced setae.

Distributional ecology. A high arctic species, extending into the North Atlantic and the northern Bering Sea, in subtidal shelf depths.

Taxonomic commentary. *Monoculopsis vallentini* Stebbing, 1914, the other described species assigned to this genus, is known only from the Falkland Islands.

Synchelidium Sars (sens. lat.)

Synchelidium G. O. Sars, 1895: 317.—Stebbing, 1906: 241.—Lincoln, 1979: 344.—Ledoyer, 1993: 607.—Ishimaru, 1994. 62.

Type genus. *Synchelidium* G. O. Sars, 1895.

Genera. *Hongkongvena* Hirayama, 1992; *Chitinomandibulum* Jo, 1990; *Eochelidium*, new genus (p. 119); *Sinoediceros* Shen, 1955; *Finoculodes* J. L. Barnard, 1971; *Americhelidium*, new genus (p. 122); *Perioculodes* Sars, 1895; *Pontocrates* Boeck, 1871.

Diagnosis. (partly from keys of Barnard & Karaman 1991): Small, gnerally smooth-bodied oedicerotids having: gnathopod 2 elongate, with elongate (usually cheliform) propod, and typically subchelate gnathopod 1, in both of which the carpus is short, and the carpal lobe elongate, guarding (or fused with) the posterior margin of the propod.

Head, rostrum strong, usually deflexed distally. Pigmented eyes (rarely lacking) partially or totally on rostrum. Antennae sexually dimorphic, non calceolate; accessory flagellum lacking. Antenna 1 short (both sexes), flagellum callynophorate in male. Antenna 2, flagellum elongate in male, but peduncle segments 3-5 lacking brush setae.

Mouthparts: Upper lip simple, smooth below. Lower lip, inner lobes partly or totally fused medially. Mandibular molar reduced, apex spinose, non triturative; palp segment 3 often sexually dimorphic (short in female). Maxilliped with tendency to reduction of plates.

Peraeopods 3-6 strongly fossorial; segment 5 <segment 6; dactyls small, chitinous rings lacking. Peraeopod 7, segment 5 usually longer than segments 4 or 6.

Synchelidum G. O. Sars, restricted

Synchelidium G. O. Sars, 1895: 317.— Stebbing, 1906: 241.— Lincoln, 1979: 344.—Ledoyer, 1993: 607.
Synchelidium Sars (part), Barnard & Karaman, 1991: 566.

Type species. *Synchelidium haplocheles* Grube, 1864.

Species. S. *tenuimanum* Norman, 1895; *S. maculatum* Stebbing, 1906; *S. intermedium* G. O. Sars, 1895; *S. longidigitatum* Ruffo, 1947.

Diagnosis. Body small, slender, smooth. Head short. Rostrum medium, apex deflexed. Eye large, basal. Antennae sexually dimorphic. Antenna 1, peduncular segment 2 shorter than 1; flagellum callynophorate and more elongate in male. Antenna 2, flagellum elongate in male.

Mouthparts modified. Lower lip, inner lobes broad, separated medially. Mandible, molar small, non-triturative, usually bearing apical spine(s); left lacinia 4-dentate, right lacinia flabellate; incisor, cutting edge weakly dentate, nearly smooth; palp regularly 3-segmented, or terminal segment reduced (esp. in females). Maxilla 1, inner plate small, with single apical seta; outer plate with 8 (?) apical spines; palp slender, 2-segmented. Maxilla 2, plates small, weakly armed. Maxilliped, inner plate small, apex 2-3 setose; outer plate relatively small, weakly armed medially; palp stout, segment 2 broad; dactyl curved.

Coxa 1 small, distally broadened; coxa 4 largest, broadest distally. Gnathopod 1 strongly subchelate; propod large, broad; carpal lobe elongate, slender, proximal to (but not fused with) hind margin of propod, apex with spine, produced beyond palmar angle; palm toothed?. Gnathopod 2 narrowly chelate or cheliform; propod slender, elongate; carpal lobe very slender, completely coalesced with the propod along the entire posterior margin, apex little or not exceeding tip of dactyl.

Peraeopods 3 & 4 strongly fossorial, dactyls usually reduced. Coxa 5 deep, medium broad, shallowly aequilobate. Coxa 6 with pronounced antero-distal lobe. Peraeopods 5 & 6 strongly fossorial, 5 distinctly the smaller; dactyls usually short. Peraeopod 7 elongate; basis narrowing distally to weak posterior lobe; segments 4-7 slender, subequal in length.

Pleon plates 1-3 rounded behind. Uropods 1-3 slender, rami subequal, margins weakly spinose. Telson short, plate-like, apex slightly emarginate to rounded, weakly armed.

Coxal gills regular. Brood plates, slender, with few apical brood setae.

Distributional Ecology. Dominant in temperate coastal waters of the eastern North Atlantic and Mediterranean, and recorded (but not authenticated) form the western N. Pacific. The single record of *S. tenuimanum* Norman from the western N. Atlantic (Watling 1981) has not been authenticated. Animals burrow in fine sand and sandy mud sediments, coastal shelf to about 100 m.

Taxonomic Commentary & relationships. *Synchelidium* is an advanced genus, its character states demonstreated in the type species *Synchelidium haplocheles* (Grube, 1864 (Fig. 29). The genus *Synchelidium* overlaps in several features with the genus *Americhelidium,* represented in the geograph-ically closest species, *A. americanum* of the western North Atlantic region. Important taxonomic differences, however, are outlined the key to genera (p. 120).

Synchelidium longidigitatum Ruffo, 1947, differs markedly from all other species of *Synchelidum* and is a serious candidate for separate subgeneric, if not full generic status of its own (see key).

Eochelidium, new genus

Synchelidium (part) Kudrjaschov & Tzvetkova, 1975: 1311.—Hirayama, 1986: 357.—Hirayama, 1987: 30.—Jo, 1990: 155.—Hirayama, 1992: 150.—Ishimaru, 1994: 62.

Type species. *Synchelidium lenorostralum* Hirayama, 1986, present selection.

Species. *Eochelidium bulytschevae* (Kudrjaschov & Tzvetkova, 1975); *E. miraculum* (Imbach, 1967); *E. carinorostrum* (Jo, 1990); *E. rostriopiculum* (Hirayama, 1987); *E. nonrostrum* (Hirayama, 1992); *E. (Chitinomandibulum) emargicoxa* Jo, 1990, and *E. (C.) ampliforbicum* (Hirayama, 1992).

Diagnosis. Body (peraeon and/or pleon) smooth to dorsally rugose . Head, rostrum short to very short, strongly deflexed apically. Eyes sexually dimorphic, located wholly on rostrum, or nearly so. Antennae sexually dimorphic. Antenna 1 (female) short, little (or not) exceeding peduncle of antenna 2. Antenna 2, peduncular segment 5 longer than segment 4.

Lower lip, inner lobes fused medially or nearly so. Mandibular molar with spine and accessory setae; right lacinia bifurcate, 1 tooth serrate; left lacinia 5-dentate; palp segment 3 not shortened in female, outer and inner margins setose. Maxilla 1, outer plate with 9 apical spines. Maxilla 2, outer plate slender; inner plate lacking facial setae. Maxilliped, inner plate with 4-8 apical setae; outer plate tall, inner margin with multiple masticatory spines; palp segment 2 not broadened medially; dactyl regular, curved.

Coxa 1, hind corner produced posteriorly, setose. Gnathopod 1 subcheliform, palm finely rugose; carpus, anterior margin distinct, lobe short, not exceeding palm. Gnathopod 2 cheliform, anterior carpal margin totally fused with propod.

Coxa 4 not broadened. Peraeopods 3 & 4, segment 5 short; dactyls medium, length not (or little) exceeding segment 6. Coxa 5 deep, aequilobate. Coxa 6, anterior lobe not produced strongly below. Peraeopods 5 & 6 subsimilar in form, but peraeopod 6 larger, stronger; segment 5 shorter than 6; dactyls medium to long. Peraeopod 7, basis strongly lobate below.

KEY TO NORTH PACIFIC GENERA OF THE *SYNCHELIDIUM* GROUP

1. Peraeopod pairs 3 & 4, 5 & 6, segment 5 not shorter (usually longer) than segment 6; peraeopods 3 & 4, dactyls very short, often masked by apical setae. gnathopod 2 cheliform ..... 2.
—Peraeopod pairs 3 & 4, 5 & 6, segment 5 distinctly shorter than segment 6; peraeopods 3 & 4, dactyls regular, length >1/3 segment 6; gnathopod 2 subcheliform (except *Eochelidium*)..... 4.

2. Gnathopod 2, carpal lobe variously fused to propod, line of demarcation mostly indistinct or lacking; antenna 1, peduncular segment 2 shorter than segment 1; peraeopod 6, coxa strongl.y produced antero-ventrally; maxilla 1, outer plate with 7 apical spines ..... 3.
—Gnathopod 2, carpal lobe not fused to propod, line of demarcation distinct throughout; antenna 1, peduncular segment 2 long, >segment 1; peraeopod 6, coxa not strongly produced antero-ventrally; maxilla 1, outer plate with 9 apical spines ..... *Pontocrates* Boeck.

3. Gnathopod 1, propodal palm strongly toothed; pleon plate 2, hind corner broadly rounded; peraeopod 7, basis lacking distinct postero-distal lobe..... *Synchelidium* Sars (sens str.) (p.119).
—Gnathopod 1, propodal palmar margin smooth; pleon plate 2, hind corner squarish or acutely produced; peraeopod 7 with distinct postero-distal lobe ..... *Americhelidum,* n. g. (p. 122).

4. Maxilla 1, outer plate with 9 apical spines; mandibular palp segment 3 with 2-5 outer marginal setae. 5.
—Maxilla 1, outer plate with 7 apical spines; mandibular palp segment 3, outer margin lacking setae (single seta rarely present)..... 6.

5. Mandibular right lacinia subequally bifid; coxae 3 & 4, lower margins incised; telson apically rounded; gnathopod 2, propod relatively short, chela long (~1/2 length of propod).... *Chitinomandibulum* Jo.
—Mandibular right lacinia unequally bfid; coxae 3 & 4 gently convex below; telson apically truncate or notched; gnathopod 2, propod elongate, chola short (>1/3 propod length . . .*Eochelidium,* n. g. (p. 119).

6. Gnathopods 1 & 2, carpus, anterior margin elongate, about equal to propod; carpal lobes short, divergent, not reaching palmar margin ..... *Hongkongvena* Hirayama.
—Gnathopod 1 & 2, carpus, anterior margin short or indistinguishable; carpal lobes elongate, closely guarding propod, reaching to or exceeding palm ..... 7.

7. Gnathopods 1 & 2 dissimilar in form and size; gnathopod 2, propodal palm perpendicular; mandibular palp segment 2 & 3 subequal in length; pigmented eyes lacking ..... *Finoculodes* J. L. Barnard.
—Gnathopods 1 & 2 subsimilar, propods elongate; gnathopod 2, propodal palm oblique; mandibular palp segment 3 distinctly shorter than 2; pigmented eyes usually present ..... 9.

8. Maxilliped, outer plate very short, not exceeding palp segment 1; dactyls of peraeopod 3 & 4 elongated, length exceeding segment 6 ..... *Sinoediceros* Shen.
—Maxilliped, outer plate normal, reaching variously along palp segment 2; dactyls of peraeopods medium in length, not exceeding segment 6 ..... *Perioculodes* G. O. Sars.

Pleon plate 2, hind corner obtuse, subquadratre, or weakly acute, not broadly rounded. Uropods 1 & 2, outer ramus the shorter. Uropod 3, rami subequal. Telson, apical margin straight or slightly emarginate, unarmed; penicillate setae arising distally.

Coxal gills large, elongate, lobate. Brood plates very slender, elongate, with distal marginal setae.

Etymology: Combining the Greek prefix "*eo*" meaning "dawn" (primitive) and the suffix "*chelidium*", in reference to the plesiomorphic nature of most character states of the genus.

Distributional ecology. Species of *Eochelidium* are known only from the western North Pacific region, from southern Sea of Japan to Vietnam, in shallow inshore waters. They overlap northward with *Americhelidium gurjanovae* (Kudrjaschov & Tzvetkova) and other relatively primitive species of that essentially North American Pacific genus.

Taxonomic commentary. *Eochilidium* is a primitive genus, readily separable from other members of the *Synchelidium* group by characters of the key (p.120). *Eochelidium ampliforbicum* Hirayama overlaps taxonomically with *Chitinomandibulum emargicoxa* Jo, 1990. Common character

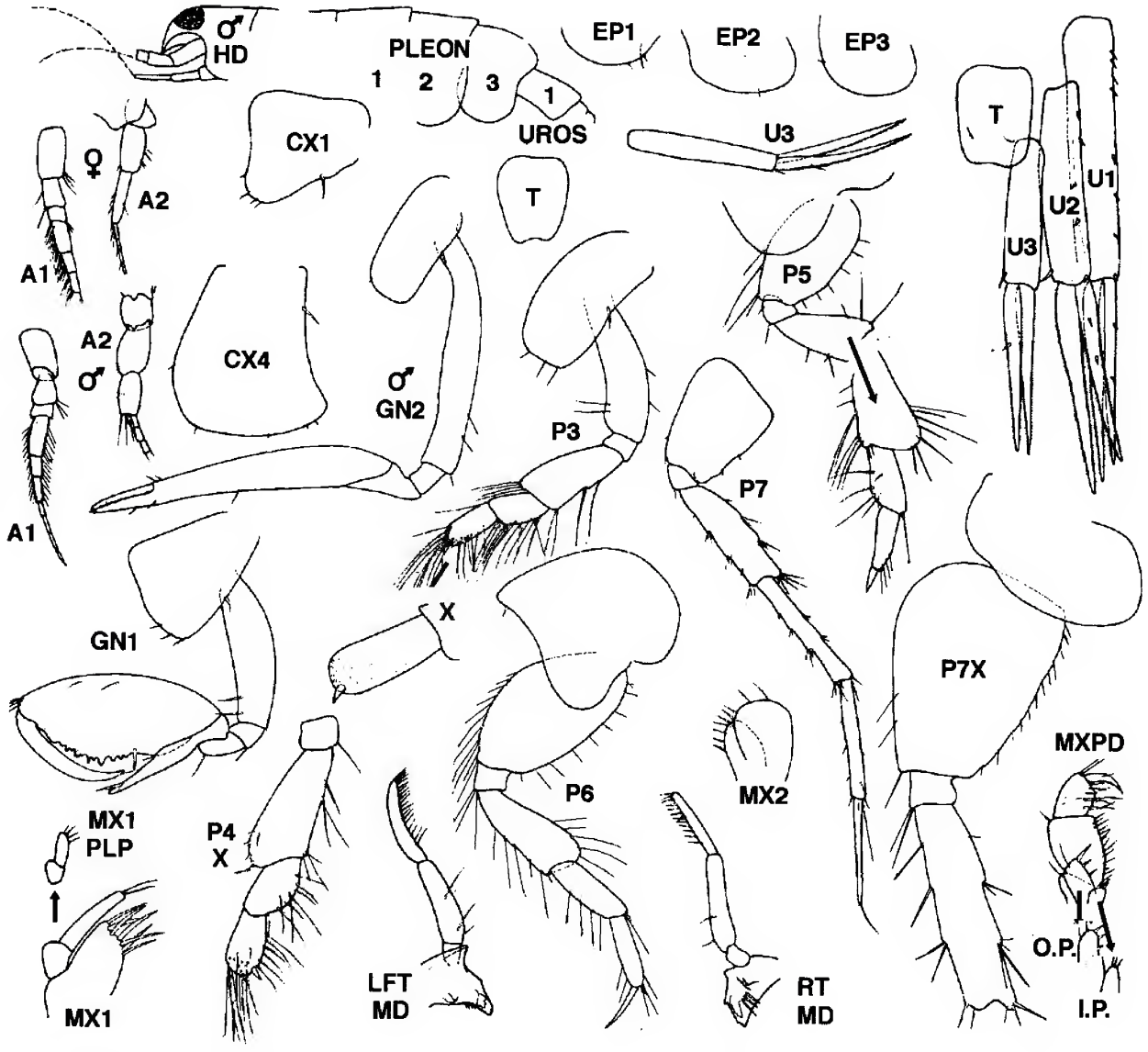

FIG. 29. *Synchelidium haplocheles* Grube, 1864. Male (2.8 mm). Mediterranean region. (after Ledoyer, 1993).

states include a bifurcate right lacinia, ventrally notched coxae 3 & 4, shallow coxa 5, short propod of gnathopod 2, weakly (or non-) lobate basis of peraeopod 7, and rounded (non-emarginate) apical margin of the telson. Such a degree of character state overlap within regional species might suggest, therefore, that the genus *Chitinomandibulum* Jo, 1990, be considered a subgenus within the genus *Eochelidium*, pending further comparative study.

Eochelidium lenorostralum (Hirayama)
(Fig. 30)

Synchelidium miraculum lenorostralum Hirayama 1986: 362, figs. 5-7.—Barnard & Karaman, 1991: 566.
Synchelidium lenorostralum Ishimaru, 1994: 62.

Taxonomic commentary. This species is closely similar to *E. miraculum* and other members of the genus from the South China Sea, in having unshortened dactyls of peraeopods 3 & 4. In this respect, members of the genus *Eochelidium* resemble *Synchelidium longidactylus* of the Mediterranean region (see Ledoyer, 1993). However, that species may require separate generic status because of its unique character states (see above, p. 119).

Eochelidium lenorostralum is fully (specifically) distinct from *S. miraculum* Imbach in which the rostrum is perpendicularly deflexed, the hind corner of pleon 2 is squared (not acute), the telson less strongly emarginate, and the mandibular palp less spinose. However, *S. lenorostralum* is distinct in its thickened maxilliped palp segment 2, and bifurcate principal molar spine.

KEY TO WESTERN NORTH PACIFIC SPECIES OF *EOCHELIDIUM* (INCL. *CHITINOMANDIBULUM*).

1. Peraeopod 7, basis, postero-distal lobe very weak, or lacking; coxa 5 shallow, width nearly twice depth; gnathopod 2;,propod relative short & stout, dactyl nearly half its length; mandible, right lacinia evenly (symmetrically) bifid . . . . *Chitinomandibulum* Jo 2.
—Peraeopod 7, basis, postero-distal lobe well-developed, covering ischium; coxa 5 nearly as deep as broad; gnathopod 2; propod relatively slender, dactyl 1/5 to 1/3 its length; mandible, right lacinia irregularly bifid or flabellate . . . .*Eochelidium* . 3.

2. Pleon plate 2 , hind corner broadly obtuse . . . . *C. ampliforbicum* (Hirayama).
—Pleon plate 2, hind corner squarish . . . . *C. emargicoxa* Jo.

3. Peraeopods 3 & 4, dactyls elongate, length < segment 6 (propod) . . . . .4.
—Peraeopods 3 & 4, dactyls relatively short, length not exceeding propod . . . . 5.

4. Pleon segments dorsolaterally ridged or carinate, surface "goose-bumped"; antenna 1, peduncular segment 2 elongate, length <segment 1. . . . . *E. nonrostrum* (Hirayama)
—Pleon segments smooth above; antenna 1, peduncular segment 2 not longer than segment 1 . . . .*E. carinorostrum* (Jo).

5. Peraeopods 3 & 4, carpus lacking posterior marginal setae . . . . *E. bulytschevae* (K. & B)
—Peraeopods 3 & 4, hind margin of carpus spinose or setose . . . . 6.

6. Coxa 3 incised below; uropods 1 & 2 rami subequal . . . . *E. nonmiraculum* (Hirayama)
—Coxa 3 gently convex below; uropods 1 & 2, outer ramus shorter than inner ramus . . . . 7.

7. Pleon 2, hind corner acute; uropods 1 & 2, rami subequal . . . . *E. lenorostralum* (Hirayama)
—Pleon 2, hind corner squarish or rounded; uropods 1 & 2, outer ramus shorter . . . . 8.

8. Rostrum very short, fused eyes at apex; peraeopods 3 & 4, propod strongly spinose posteriorly; gnathopod 2, propod very slender . . . . *E. rostriospiculum* (Hirayama)
—Rostrum regular, fused eyes subapical; peraeopods 3 & 4, propod, hind margin proximally setose; gnathopod 2, propod thicker. . . . .*E. miraculum* (Imbach)

Americhelidium, new genus

Synchelidum (part) Mills, 1962: 14.—Bousfield, 1973: 98.—Barnard, 1977: 877.—Hirayama, 1986: 357.—Barnard & Karaman, 1991: 560?

Type species. *Synchelidium spinipes* Mills, 1962 (present designation).

Species. *Americhelidium rectipalmum* (Mills, 1962); *A. gurjanovae* (Kudrjaschov & Tzvetkova, 1975); *A. latipalpum* (Hirayama, 1986); *A. micropleon* (J. L. Barnard, 1977); A. *americanum* (Bousfield, 1973); *A. millsi*, new species (p. 134); *A. pectinatum*, new species (p. 129); *A. variabilum*, new species (p. 132); *A. setosum*, new species (p. 125); A. shoemakeri (Mills, 1962).

Diagnosis. Medium to relatively large species, distinguished by the characters of the key (p. 124) and the following.

Antennae 1 & 2 sexually dimorphic. Flagella (female) subequal, short, 4-10-segmented. Antenna 1 (female), peduncular segment 2 shorter than 1.

Lower lip, inner lobes fused medially or nearly so. Mandibular palp segment 3 shorter in female, shorter than segment 2, lacking outer marginal setae; right lacinia bifid; incisor weakly toothed; molar with 1-2 spines. Maxilla 1, outer plate with 7 apical spines; palp segment 2 weakly setose. Maxilla 2, outer plate not expanded or truncate distally. Maxilliped, inner plate short, with 2-4 apical setae; outer plate short to medium, with 3-8 inner marginal spines; palp segment 2 stout.

Coxae 1-4 deep, 3 broad, 4 very broad, usually acutely produced behind. Coxa 5 deep, weakly postero-lobate; coxa 6 deep, strongly anterolobate. Gnathopods 1 & 2 dissimilar. Gnathopod 1 strongly subchelate; carpus, anterior margin short, posterior lobe slender, extending beyond palm of propod; palm of propod nearly vertical, weakly toothed. Gnathopod 2 less powerful, cheliform; anterior margin of carpus small but free, not fused to propod, carpal lobe fused to posterior margin of elongate propod, line of demarcation often visible.

Peraeopods 3 & 4, segment 5 longer than 6, dactyls very short or minute. Peraeopods 5 & 6, bases somewhat unlike in size and form, with strong median row of plumose setae; segment 5 longer than 6; dactyls very short. Peraeopod 7, basis markedly posterolobate, often with strong antero-

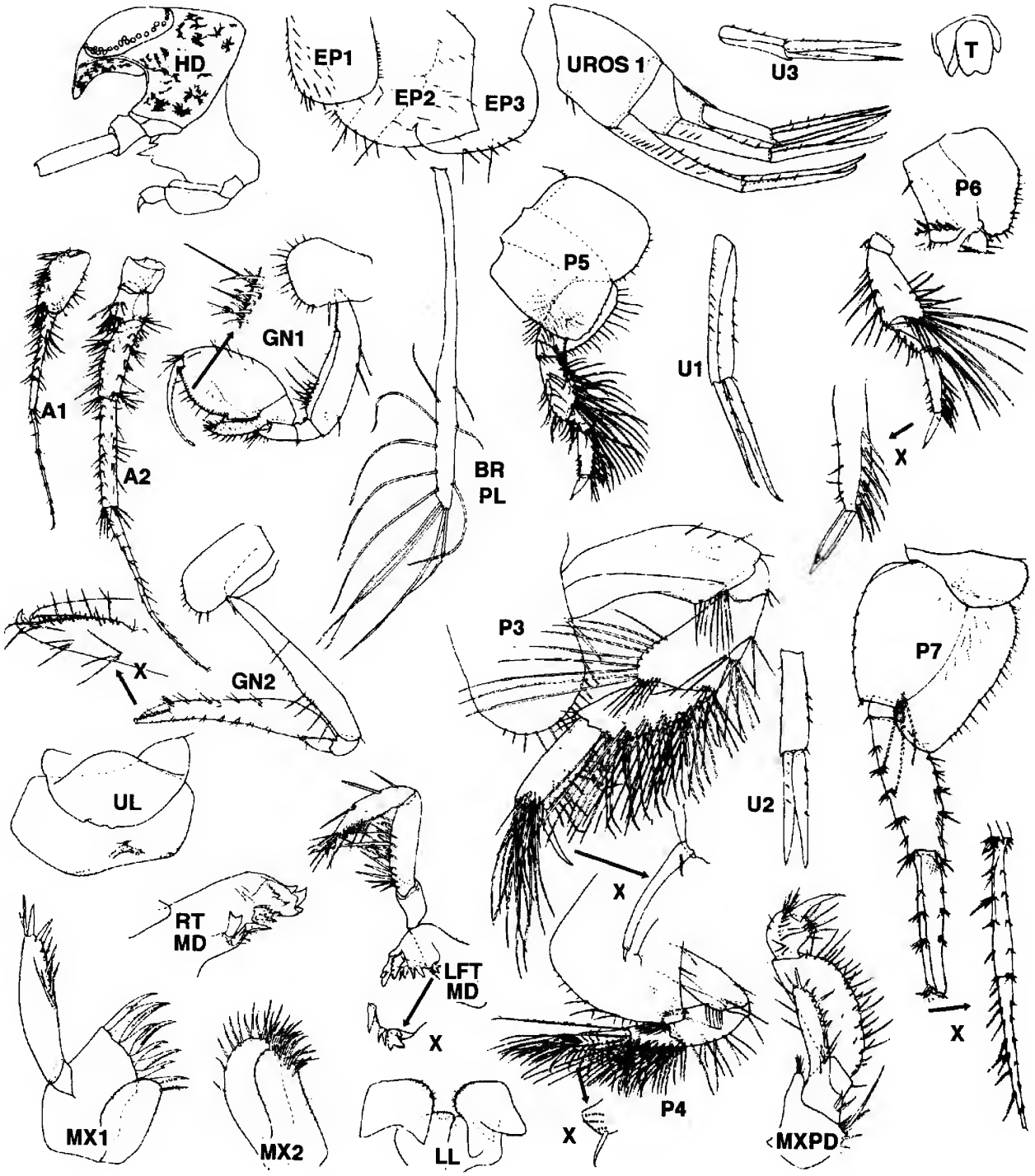

Fig. 30. ***Eochelidium lenorostralum*** **(Hirayama). Japan, northeastern shores. Female (4.75 mm). (after Hirayama, 1986)**

proximal row of short spines; dactyl elongate, margins setose and/or spinose.

Pleon plate 2, hind corner subquadrate or variously produced; pleon plate 3 subquadrate or obtuse.. Uropods 1-3, rami slender, margins weakly spinose, outer ramus generally the shorter. Telson short to medium, apex truncate or rounded, unarmed.

Coxal gills and brood plates regular.

Etymology. *Americhelidium* combines the geographical name "America" and the Greek root suffix "*chelidium*", in reference to the preponderance of North American endemic species in this cheliform oedicerotid subgroup.

Distribution: Species of *Americhelidium* occur in the

KEY TO NORTH PACIFIC SPECIES OF *AMERICHELIDIUM*

1. Coxa 4 very broad, acutely produced behind; peraeopod 6 antero-distal lobe deep, sharply rounded; gnathopod 1, palm of propod variously oblique; gnathopod 2, dactyl small, 1/4-1/6 length of propod; maxilliped outer plate short, not reaching beyond 1/2 palp segment 2 . . . . . 2.
—Coxa 4 regular, posterior angle little produced; peraeopod 6, antero-distal lobe shallowly rounded; gnathopod 1, palm of propod perpendicular; gnathopod 2, dactyl large, ~ 1/3 length of propod; maxilliped, outer plate tall, reaching beyond !/2 palp segment 2 . . . . . .*A. rectipalmum* (Mills) (p.125)

2. Gnathopod 1, palm of propod markedly oblique; pleon plate 2, hind corner acutely produced; coxa 5, posterior lobe, lower margin nearly bare . . . . . 3.
—Gnathopod 1, palm of propod slightly oblique; pleon plate 2, hind corner subquadrate or acuminate, not produced; coxa 5, hind lobe, lower margin variously setose . . . . . 5.

3. Gnathopod 2, propod slender, elongate, length ~7X greatest depth; gnathopod 1, basis with strong cluster of anterior marginal setae; mandibular palp segment 2 long, greater than 1/2 palp segment 2 . . . . . .*A. millsii* n. sp. (p. 134).
—Gnathopod 2, propod medium-stout, length 5-6 X greatest depth; gnathopod 1, basis, anterior margin nearly smooth; mandibular palp segment 3 (female) short, length <1/2 segment 2 . .*A. shoemakeri* (p. 132)

4. Peraeopod 3, segment 6 relatively long, length >2 X depth; propod of gnathopod 2 short, length ~4-5 X maximum depth; mandibular palp segment 3 (female)long, length <1/2 palp segment 2; maxilliped outer plate medium; nearly reaching halfway point of palp segment 2 . . . . . 5.
—Peraeopod 3 segment 6 very short, length ~1.5 X depth; propod of gnathopod 2 relatively long, length 5- 6 X greatest depth; mandibular palp segment 3 (female) short, length > 1/2 palp segment 2; maxilliped outer plate very short, barely reaching palp segment 2 . . . . . 7.

5. Pleon plate 2, hind corner acute; uropod 3 regular, little (or not) exceeded by uropod 2; apical margin of telson broadly rounded; mandibular blades regular, slender . . . . . 6.
—Pleon plate 2, hind corner obtuse; uropod 3 short, much exceeded by uropod 2; telson, apical margin sharply rounded; mandibular blades thick, stout . . . . . .*A. micropleon* (Barnard) (p. 137).

6. Peraeopod 7, basis, postero-distal lobe large, extending below ischium; maxilla 1, outer plate spines large, strongly pectinate, some extending beyond palp . . . . . *A. pectinatum* n. sp. (p. 129)
—Peraeopod 7, basis, postero-distal lobe small, not reaching ischium; maxilla 1, outer plate, apical spines of regular form, none extending beyond apex of palp. . . . . *A. variabilum* n. sp. (p. 132)

7. Peraeopod 7, basis, postero-distal lobe large, extending below ischium; uropod 3, inner ramus with 1-2 marginal spines . . . . . 8.
—Peraeopod 7, basis postero-distal lobe shallow, not extending below ischium; uropod 3, inner ramus with 3-6 marginal spines . . . . . 9.

8. Antennae (female) short, flagellum of each shorter than peduncle; mandibular palp segment 3 large, broad, length = segment 2; western North Pacific. . . . . *A. latipalpum* (Hirayama) (p. 128).
—Antennae relatively long, flagellum longer than peduncle; mandibular palp segment 3 short, slender, length <palp segment 2; western N. Atlantic . . . . . *A. americanum* (Bousfield) (p. 128).

9. Coxa 1, lower margin densely setose (30-40 setae); uropod 2, inner ramus with 3-4 marginal spines; gnathopod 1, carpus, anterior margin relatively broad . . . . . .*A. setosum* n. sp. (p. 125).
—Coxa 1, margin regularly setose (10-20 setae); uropod 2, inner ramus with 6 marginal spines; gnathopod 1, carpus, anterior margin very narrow . . . . . *A. gurjanovae* (K. & T.) (p. 128).

North Pacific coastal marine region, mainly along boreal to warm-temperate North American shores, but a few are recorded from the Asiatic Pacific shores (northern Sea of Japan), and one species from warm-temperate shores of the North American Atlantic region.

Taxonomic commentary: *Americhelidium* is closely related to the European Atlantic genus *Synchelidium* (sens. str.) but differs in a mixture of apomorphic and plesiomorphic character states listed above and in the key to genera (p. 124).

Americhelidium rectipalmum (Mills)
(Fig. 31)

Synchelidum rectipalmum Mills, 1962: 17, fig. 5.—J. L. Barnard, 1975: 363, + key, fig. 137.—Austin, 1985: 591.—Staude, 1987: 378.—Barnard & Karaman, 1991: 566.

Material Examined. ~125 specimens in 63 lots:
ALASKA: Unimak I., P. Slattery Stns. C2, C4, C22, C25, C49, C66, C67, 1982 - 16 specimens, including 4 males (to 3.5 mm) and 12 females (to 3.5 mm), CMN cat. nos. NMCC-1991-1018-1026.
Southeastern Alaska. ELB Stns., June-July, 1961: A18, A30, A57, A75, A87, A91, A92, A96, A117, A139, A175 - 22 specimens, including 1 male (**fig'd specimen**), 15 females.
ELB Stns., July, 1980: S1F2, S4B1, S4B3, S4B4, S23F1 - 11 specimens, including 1 male, 1 females.

BRITISH COLUMBIA:
Queen Charlotte Islands. ELB Stns., July-August, 1957: H2, H2a, H3, H8b, H9 - 31 specimens, including 8 males, 19 females.
North-central mainland coast. ELB Stns., July, 1964: H3, H7, H21, H25, H26, H47, H52, H53, H57, H62 - 31 specimens, including 3 males, 8 females.
South-central mainland coast. ELB Stn. E4, Nov. 4, 1977 - 2 immatures.
Vancouver Island, north end. ELB Stns., July, 1959: N11, V3, V4b - 3 males, 2 females
Vancouver Island South end. ELB Stns., July, 1970: P710, P721 - 1 male, 2 females. ELB. Stns., July, 1975: P8, P13, P26, P28a - 39 specimens. ELB Stns., July 1876: B10, B20, B22, B26, B27 - 43 specimens. ELB Stns., May, 1977: B1, B6, B13 - 13 specimens.
K.E. Conlan Stn., Saanich inlet, 1975 - 1 specimen. D.V. Ellis Stns. (off James I.), 1979: 2202, 2601 - 3 specimens.
G. W.O'Connell Stn. 4-B (off McCauley Pt.), 1976. - 1 male.

WASHINGTON:
ELB Stns., July, 1966: W13 (4 females, incl. **fig'd specimen**, 2 immatures); W39 (7 females). CMN coll'ections, Ottawa.

Diagnosis: Female ov. (6.0 mm). Head, rostrum short, deflexed. Fused eyes large, subapical on rostrum. Antenna relatively long, flagella 8-10 segmented.

Mandible, molar with 2 unequal apical spines; spine row with 3-4 regular blades, right lacinia broadly bifid; palp segment 3 short, weakly setose, length about half segment 2. Maxilla 1, outer plate, apical spines ordinary, not exceeding palp. Maxilliped, inner plate with 4 apical setae; outer plate tall, extending beyond half of stout palp segment 2.

Coxa 1, hind corner enlarged posteriorly, hind margin with single stout spine, lower margin strongly setose. Coxa 2, hind margin with single spine. Gnathopod 1, basis with strong antero-distal cluster of setae; propod strong, palm weakly toothed, hinge portion vertical (perpendicular to axis of propod); carpus narrow, hind lobe slender, apex with single spine, extending slightly beyond palm. Gnathopod 2, basis slender, hind margin with 1-2 long setae; propod relatively short, thick, length about 4.5 X maximum depth; dactyl strong, length ~ 1/3 propod.

Coxa 4 little broadened, hind corner acute, not strongly produced. Peraeopods 3 & 4, distal segments not exceptionally setose; length of segment 6 about 2X depth, dactyl very short. Coxa 5 medium deep, aequilobate, hind lobe weakly setose below. Coxa 6, antero-distal lobe shallow, broadly rounded. Peraeopods 5 & 6, bases subsimilar, 6 the larger; dactyls medium short. Peraeopod 7, basis regularly broadened, hind margin convex, postero-distal lobe medium, not extending beyond ischium; inner facial row of 4-5 plumose setae.

Pleon side plate 2, hind corner subquadrate; plate 3 rounded behind. Uropods 1-3, outer ramus (of each) slightly the shorter, extending equidistant posteriorly. Uropod 3, inner ramus with 4 marginal spines.

Telson relatively broad, apical margin broadly rounded, penicillate setae median.

Coxal gills and brood plates regular.

Male (3.5 mm). Antenna 1, peduncular segments 2 & 3 shorter than in female; basal flagellar segments not callynophorate, not bearing numerous aesthetascs. Antenna 2, peduncular segments 4 & 5 short, lacking anterior marginal brush setae; flagellum elongate, 40-45 segmented.

Mandibular palp segment 3, length 2/3 segment 2, inner margin with regular pectinate "D" setae.

Distributional ecology. From Unimak I., and southeastern Alaska to Lower California (+ Costa Rica?), from the low intertidal and shallow subtidal to depths of 40 m., in sand and silty sand sediments.

Taxonomic commentary. *Americhelidium rectipalmum* is a relatively primitive species, with no close relatives (Fig. 42, p. 142), possibly meriting subgeneric recognition of its own. Although ranging into the Bering Sea region, it appears less closely related to the two known Asiatic Pacific species than are *A. setosum*, and the western North Atlantic species, *A. americanum*.

The species varies in morphologically and size at maturity throughout its geographical and bathymetrical range, especially in the region of Juan de Fuca Strait.

Americhelidium setosum, new species
(Fig. 32)

Material Examined: 18 specimens, at 10 localities:
ALASKA:
Southeastern Alaska. ELB Stn. S18F3, Kamenoi Pt., Kruzof I., stones & algae on sand, 10 m., Aug. 2, 1980 - 1 female ov.

BRITISH COLUMBIA:
North-central mainland coast. ELB Stn. H23, Deadman's

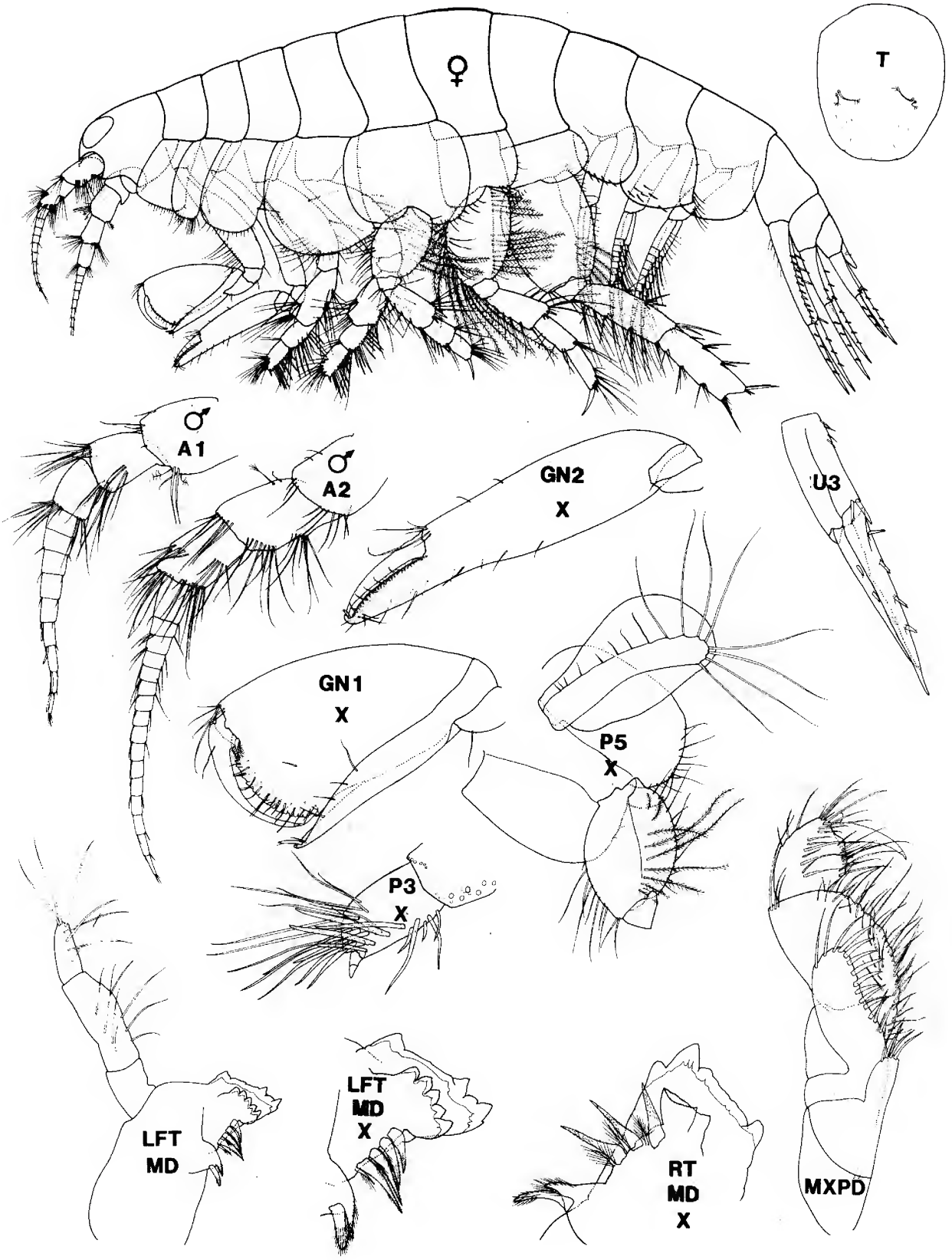

FIG. 31. ***Americhelidum rectipalmum*** **(Mills). Neah Bay, Washington. Female (6.0 mm) Port Gravina, Alaska. Male subad. (5.0 mm).**

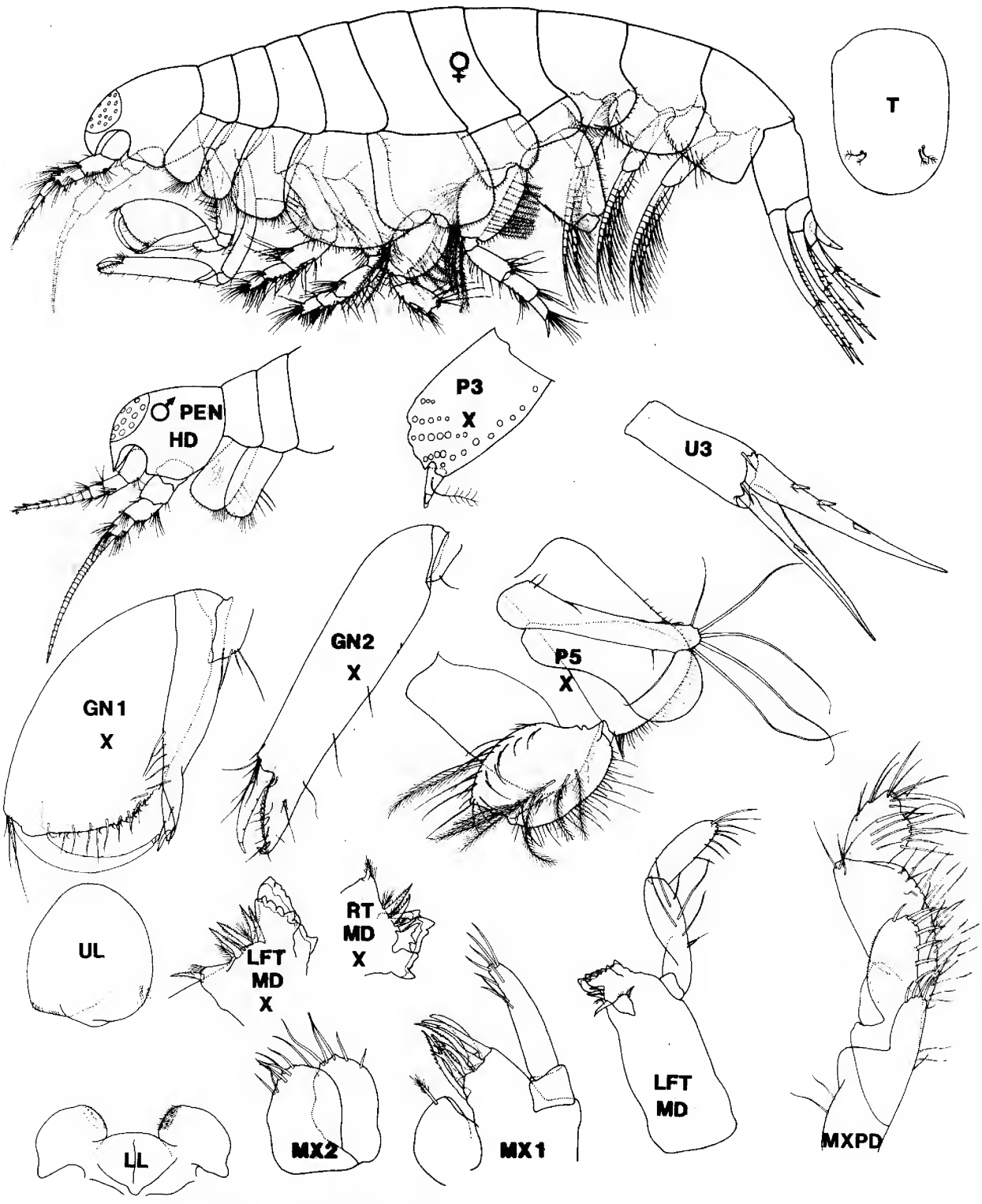

FIG. 32. ***Americhelidium setosum,*** **new species. Swanson Bay, B. C. Female (3.5 mm); male penult (3.0 mm).**

Cove, Banks I., fine sand, 3-5 m., July 18,1964 - 3 females. CMN cat. no. NMCC1991-0960.

Swanson Bay (52°00'N, 128°30' W). C. Levings Stns. A-N, April, 1973, to Nov., 1975 - female ov (3.5 mm) **Holotype;** male, penult. (3.0 mm) **Allotype.** CMN cat. no. NMCC1991-1032; 7 addition lots containing 3 males, 2 females, 7 immatures. CMN cat. nos. NMCC1990-1033 to 1039.

Diagnosis. Female ov. (3.5 mm). Head, rostrum large, strongly deflexed. Fused eyes large, fully on rostrum. Antenna relatively short, flagella 4-6 segmented.

Mandible, molar with single strong apical spine; spine

row with 3-4 regular blades; right lacinia broadly trifid; palp segment 3 relatively large, distally with a few medium long setae, length about 3/4 segment 2. Maxilla 1, outer plate, apical spines relatively long but not exceeding palp. Maxilla 2, plates short, broad, weakly setose. Maxilliped, inner plate with 3 apical setae; outer plate medium, extending about half way along relatively slender palp segment 2.

Coxa 1 broad, hind corner squarish, hind margin with stout spine and several setae, lower margin strongly setose (30-40). Coxa 2 less broad, hind margin with spine and several setae. Gnathopod 1, basis with weak antero-distal cluster of setae; propod strong, slightly narrowing distally; palm steeply oblique, weakly toothed near postero-distal angle; carpus relatively broad, hind lobe narrowing, apex with single spine, extending slightly beyond palm. Gnathopod 2, basis slender, hind margin with single long setae; propod relatively short, thick, length 4.5 - 5 X maximum depth; dactyl strong, length ~ 1/4 propod.

Coxa 4 strongly broadened distally , hind corner acute, produced. Peraeopods 3 & 4, distal segments normally setose; segment 6, length about 2X depth, dactyl very short. Coxa 5 nearly as deep as coxa 4, slightly postero-lobate, hind lobe short-setose below. Coxa 6, antero-distal lobe medium, regularly rounded. Peraeopods 5, basis more broadly ovate than in peraeopod 6; dactyls medium short. Peraeopod 7, basis narrowing distally hind margin straight, short-setose, postero-distal lobe medium, not extending beyond ischium.

Pleon side plates 2 & 3, hind corners squared. Uropods 1-3, outer ramus (of each) distinctly the shorter, those of uropods 1 & 2 exceeding uropod 3. Uropod 3, inner ramus with 3 marginal spines.

Telson medium broad, apical margin broadly rounded, penicillate setae distal.

Coxal gills and brood plates regular.

Penultimate male (3.0 mm). Antenna 1, peduncular segments 2 & 3 shorter and less setose than in female; flagellum 7-segmented. Antenna 2, metamorphosing flagellum 20+ segmented.

Mandibular palp segment 3 as in female.

Etymology. From the Latin "*setosus*" - hairy, in reference to the strongly setose lower margin of coxa 1.

Distributional Ecology. From the Sitka region, southeastern Alaska, to central British Columbia, on sandy mud bottoms, from the low water level to depths of 52 m., in temperatures of 5.9-7.^{o}C., and salinities of 31.6 to 33.4‰.

Taxonomic commentary. *Americhelidium setosum* is a relatively primitive species, closely allied to *A. americanum* of the western North Atlantic and to *A. gurjanovae* and *A. latipalpum* of the Sea of Japan (Fig. 42, p. 142). These species are similar in having a single strong apical molar spine, but the inner lobes of the lower lip are less closely fused medially in *A. americanum.*

Asiatic North Pacific species of *Americhelidium*

Two western North Pacific species of the *Synchelidium* group are referable to *Americhelidium*, outlined above, viz. *A. gurjanovae* (Kudrjaschov & Tzvetkova, 1975) and *A. latipalpum* (Hirayama, 1986). Both occur in northern parts of the Sea of Japan, along shallow sandy shores.

Americhelidium gurjanovae Kudrjaschov & Tzvetkova (Fig. 33)

Synchelidium gurjanovae Kudrjaschov & Tzvetkova, 1975: 1311, fig. 3A.—Barnard & Karaman, 1991: 566.

Taxonomic commentary: *Americhelidium gurjanovae* was described and figured originally from fairly extensive material in the northern Sea of Japan (Peter-the-Great Bay and S. Sakhalin), to depths of 50 m. Descriptive data and figures leave little doubt that the species is referable to *Americhelidium* rather than to the regionally endemic genus *Eochelidium.* Among the few differences, the anterior margin of gnathopod 2 is shown fused to propod; the inner lobes of the lower lip are fused totally; and the dactyls of peraeopods 5 & 6 are medium in length.

Americhelidium latipalpum (Hirayama) (Fig. 34)

Synchelidium americanum latipalpum Hirayama, 1986: 357, figs. 1-4.—Barnard & Karaman, 1991: 566.—Ishimaru, 1994: 62.

Taxonomic commentary: Hirayama (1986) initially and perceptively described this taxon as a subspecies of *Synchelidium americanum* Bousfield, 1973. This form is clearly referable to genus *Americhelidium* in nearly all its diagnostic generic character states, but differs (probably) in lacking a reduced mandibular palp 3 in the female. Differences between the two species noted by Hirayama (loc. cit.) viz. , in apical spination of the mandibular molar, size and breadth of mandibular palp segment 3, breadth of coxa 4, and shape of the telson, are here considered of species level significance.

A. merichelidium latipalpum is close to *A. gurjanovae* but differs in characters of the key (p. 124).

Americhelidium americanus (Bousfield)

Synchelidium americanum Bousfield, 1973: 98 , pl.XX, fig. 1.—Hirayama, 1986: 357.—Barnard & Karaman, 1991: 566.

Taxonomic commentary. *Americhelidium americanum* is the only species of syncheliid yet recorded from the western North Atlantic region. Although showing some character states of *Synchelidum*, sens str., it is most closely allied with the relatively primitive *A. setosum* - *A. gurjanovae* complex of the North Pacific region (Fig. 42, p. 142).

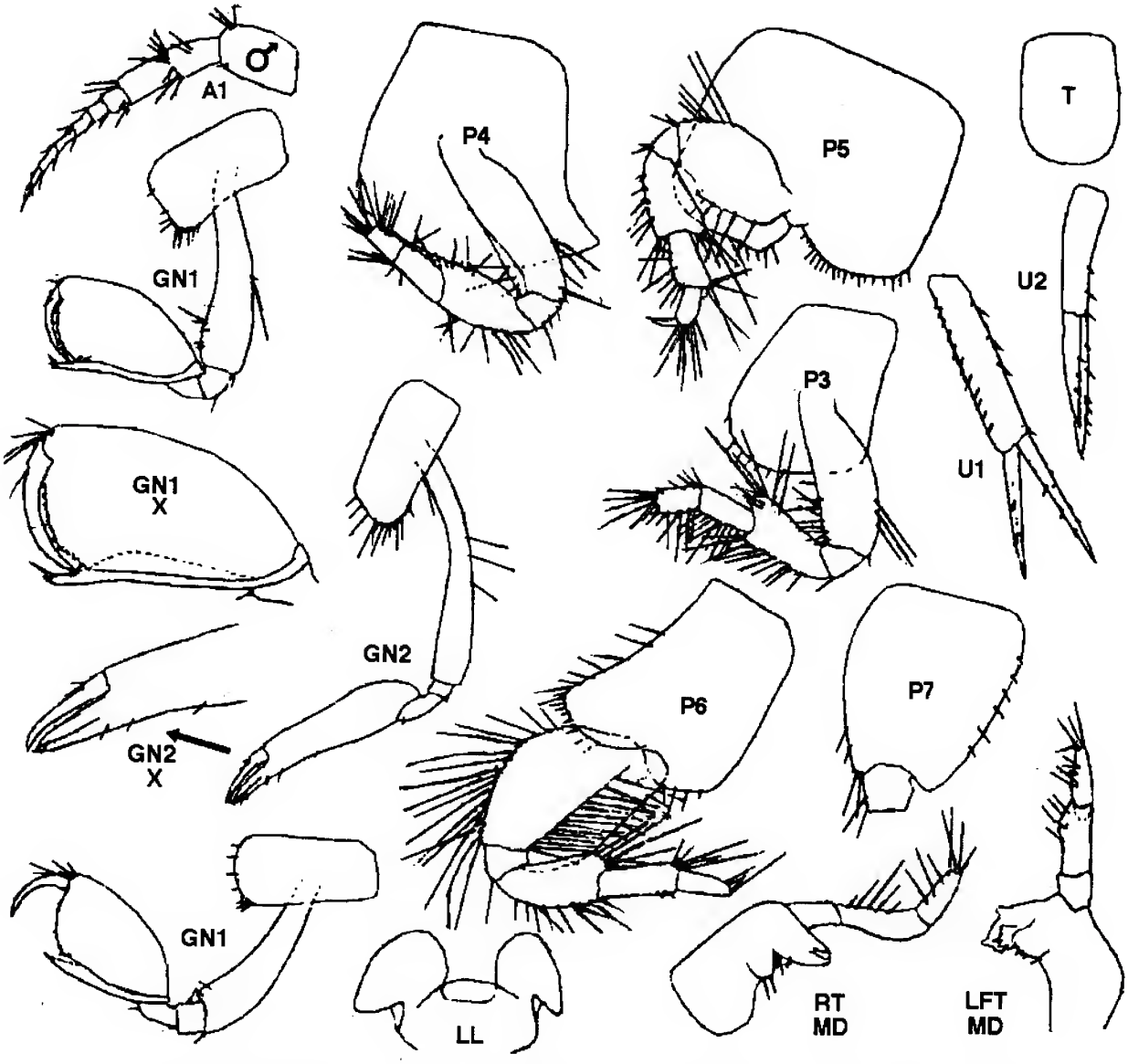

FIG. 33. ***Americhelidium gurjanovae*** **(Kudrjaschov & Tzvetkova). South Sakhalin I. Female (4.0 mm); male (3.0 mm) (after Kudrjaschov & Tzvetkova, 1975).**

Americhelidium pectinatum, new species
(Fig. 35)

Material examined. About 500 specimens in 12 station lots, mostly from one locality on the outer coast of Washington
BRITISH COLUMBIA:
North-central mainland coast. ELB Stn. H59 (off Bolivar I.) fine white and, 15 m. - 1 female ?).
Southern Vancouver Island. ELB Stn. P703 (McKenzie Beach), July 7, 1970 - 1 female.
ELB Stn P21b (McKenzie Beach), fine sand, 44-50 m., Aug. 9, 1975 - 1 immature specimen.

WASHINGTON:
ELB Stns., July, 1966: W8, W18, W20, W22, W24, W34, W40, W46 - ~460 specimens, including males, females, immatures: Type material from W18 (Cape Shoalwater) includes: female ov. (4.0 mm) **Holotype,** CMN Cat. no. NMCC 1990-0503; W46 Leadbetter Pt. - male (3.0 mm) **Allotype**, CMN cat. no. NMCC1990-0508.

Diagnosis. Female ov. (4.0 mm). Head, rostrum medium large, deflexed. Fused eyes large, fully on rostrum. Antenna relatively long, flagella 7-8 segmented.

Mandible, molar with 2 unequal apical spines; spine row with 4 regular blades, right lacinia broadly bifid; palp segment 3 short, with long inner margin and apical setae. Maxilla 1, outer plate, apical spines slender, distally strongly pectinate, some spines exceeding palp. Maxilla 2, plates apically weakly setose. Maxilliped, inner plate with 2 apical setae; outer plate very short, extending little beyond palp segment 1; palp segment 2 short, stout.

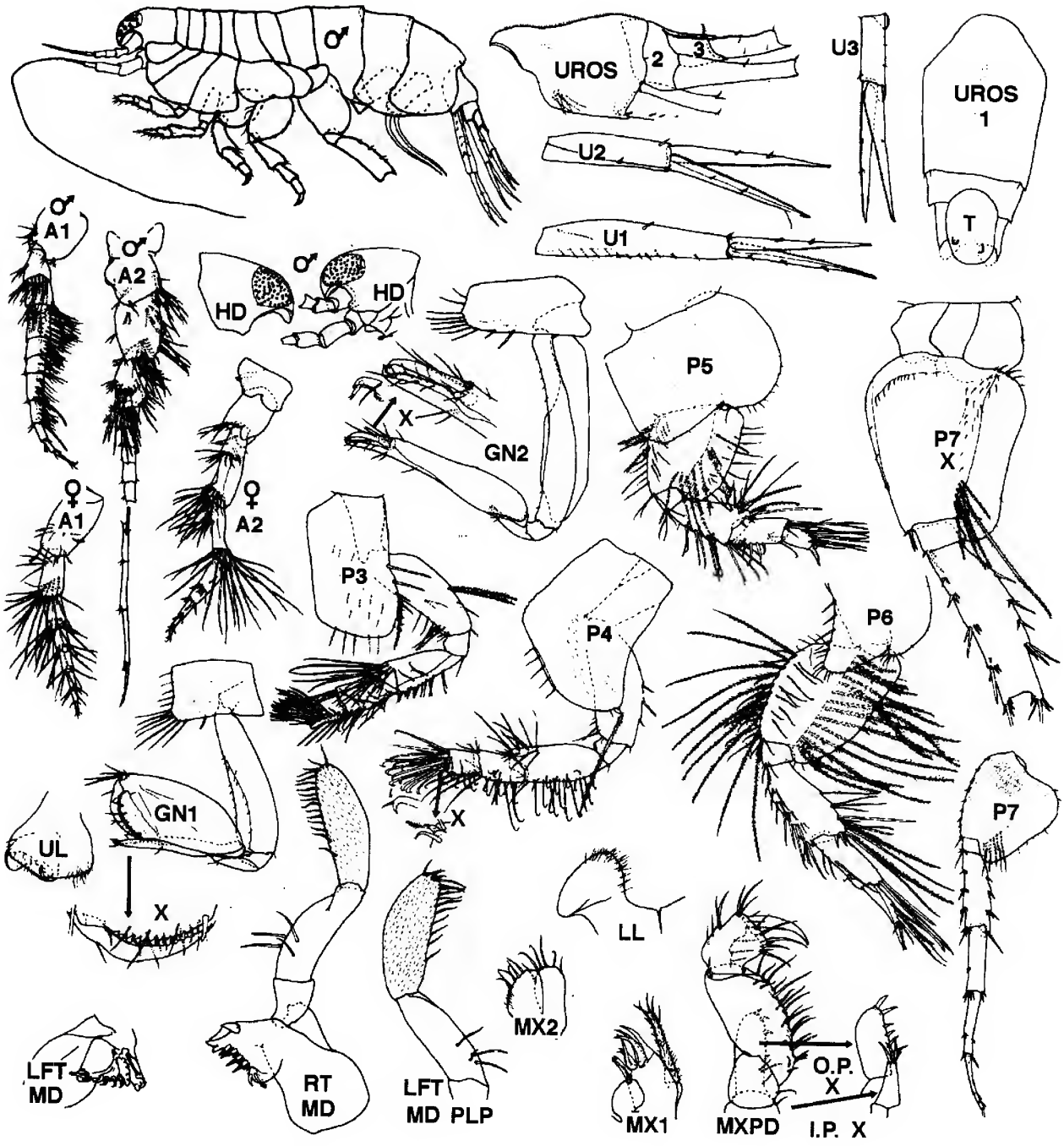

FIG. 34. *Americhelidium latipalpum* (Hirayama). Otsuchi Bay, Japan. Male (2.76 mm); female (3.5 mm). (after Hirayama, 1986).

Coxa 1, medium broad, rectangular, hind margin with stout spine and a few setae, lower margin moderately setose. Coxa 2 narrow, hind margin with 3 spines. Gnathopod 1, basis with weak antero-distal cluster of setae; propod strong, broadening distally; palm weakly denticulate, steeply oblique; carpus narrow, hind lobe slender, apex with single spine, extending beyond palm. Gnathopod 2, basis slender, hind margin with 3-4 long setae; propod medium, length ~5X maximum depth; dactyl medium, length ~ 1/5 propod.

Coxa 4 moderately broadened distally, hind corner acute, produced, not upturned. Peraeopods 3 & 4, distal segments strongly setose; segment 6 short, length little greater than depth; dactyl minute. Coxa 5 large, very broad, nearly as deep as coxa 4, aequilobate, hind lobe strongly short-setose below. Coxa 6, antero-distal lobe strong, regularly rounded. Peraeopods 5 & 6, bases subsimilar, 6 the larger; dactyls medium short. Peraeopod 7, basis narrowing slightly distally, to deep postero-distal lobe that extends beyond ischium, hind margin slightly convex; inner face with strong antero-proximal setal "comb-row", and distal median row of 5-7 plumose setae.

Pleon side plates 2 & 3, hind corners subquadrate.

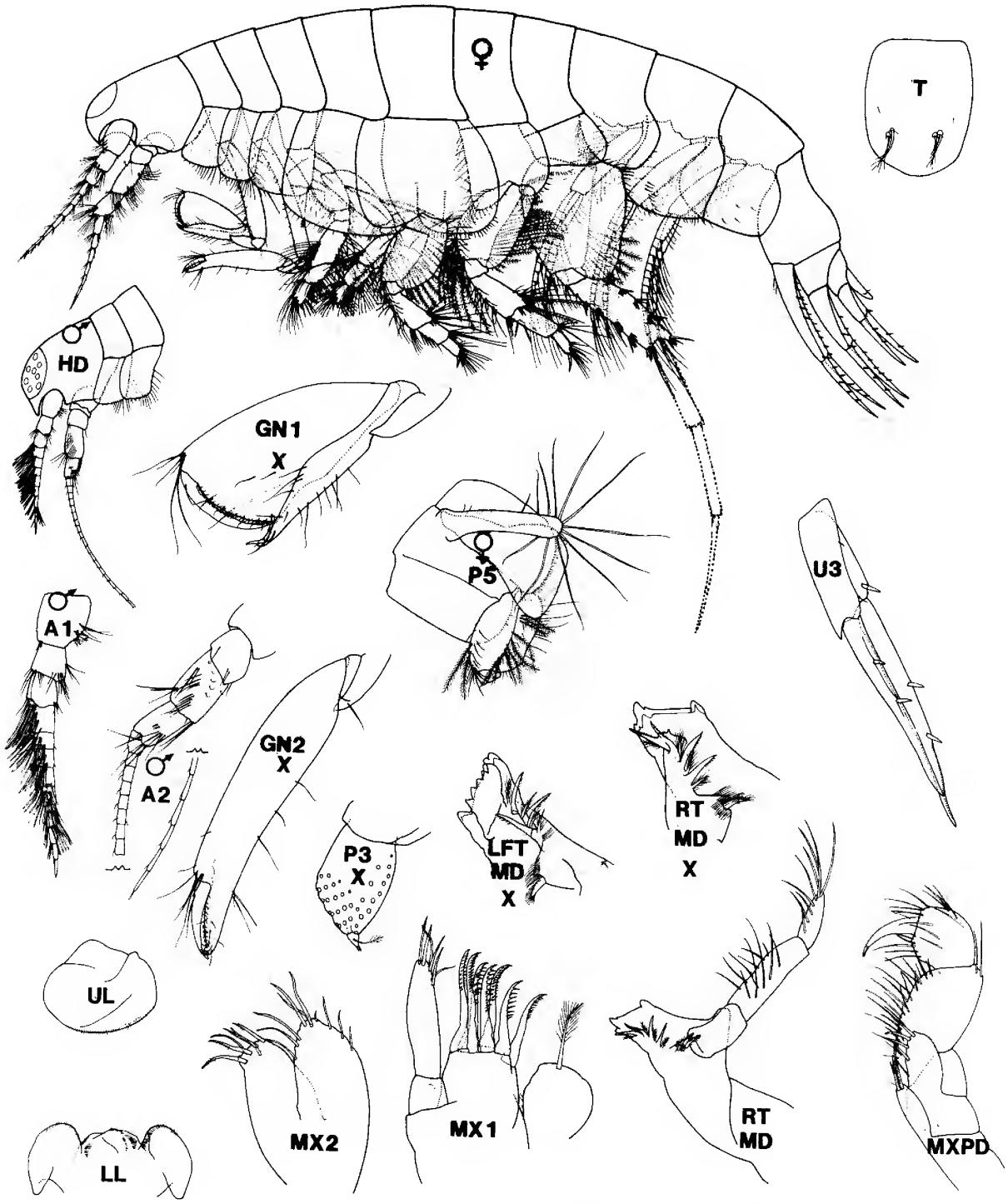

Fig. 35. ***Americhelidium pectinatum,*** **new species. Leadbetter Pt., Washington. Female (4.0 mm). Cape Shoalwater, Washington. Male (3.0 mm).**

Uropods 1-3, outer ramus (of each) slightly the shorter, those of uropod 2 extending furthest posteriorly. Uropod 3, inner and outer ramus each with 2 marginal spines.

Telson subrectangular, apical margin rounded, penicillate setae distal.

Coxal gills relatively large, broadest distally. Brood plates relatively short, with 10-12 apical setae.

Male (3.0 mm). Antenna 1, peduncular segments 2 & 3 slightly shorter than in female; flagellum 9-segmented, basal segments callynophorate but not fused, bearing numerous aesthetascs. Antenna 2, peduncular segments 4 & 5 shorter than in female, lacking anterior marginal brush setae; flagellum relatively short, 20-25 segmented.

Mandibular palp segment 3 regular, length 2/3 segment 2, inner margin with pectinate "D" setae.

Etymology. The species name is derived from the Latin "pectinatus"- comblike, with reference to the long comb-like spines of the outer plate of maxilla 1.

Distributional Ecology. From central British Columbia, southward to Washington, and possibly northern Oregon, in sandy substrata of open ocean beaches, subtidally to 50 m. Its distribution may parallel that of the open beach burrowing talitroidean, *Proboscinotus loquax* (Barnard), the distribution of which is also narrowly centred, on the open beaches of Washington state.

Taxonomic commentary. *Americhelidum pectinatum* is a moderatley advanced species of the genus, closely related to *A. variabilum* and *A. micropleon* (Fig. 42, p. 142).

Americhelidium variabilum, new species
(Fig. 36)

Material Examined: 20+ specimens from 6+ localities in British Columbia and Washington state, as follows:
BRITISH COLUMBIA:
North-central mainland coast. ELB Stn. H37, Open Bight, Queen Charlotte Sound, fine sand, 50-70 m., July 22, 1964 - 2 females; H49 (Goose I. Anchorage), fine sand, 15 m. - 2 penultimate males, 3 females, 7 immatures, CMN cat. no. NMCC1991-0969.
Vancouver Island, south end. ELB Stn. B10c (off Brady's Beach), sand, 10 m., June 28, 1976 - female (3.2 mm) (var.) ELB Stn. P1 (Pilot Cove), 44 m., Nov. 2,1977 - 1 female (2.8 mm) (variant)).
K.E. Conlan Stns. (Saanich Inlet), 1976 - several females.

WASHINGTON:
ELB. Stn. W39 (Neah Bay, Clallam Co.) east boat slip, medium coarse sand and sandy mud at LW, July 30, 1966 - 1 female ov. (3.0 mm) **Holotype**; 1 female subadult **Paratype,** CMN cat. no. NMCC1991-0914.

Diagnosis: Female ov. (3.0 mm). Head, rostrum medium, little deflexed. Fused eyes medium, partly on rostrum. Antenna relatively short, flagella 5-6 segmented.

Mandible, molar with single stout apical spine; spine row with 4 regular blades; right lacinia broadly bifid; palp segment 3 very short, with single terminal seta, length about 1/3 segment 2. Maxilla 1, outer plate, apical spines ordinary, not exceeding palp. Maxilla 2, plates not broadened, weakly setose apically. Maxilliped, inner plate with 2 apical setae; outer plate short, not attaining mid-point of very stout palp segment 2.

Coxa 1 subrectangular, hind margin with 1-2 spines, lower margin regularly setose. Coxa 2, hind margin with 3 spines. Gnathopod 1, basis sparsely with antero-distal marginal setae; propod relatively slender, palm medium short, weakly toothed, steeply oblique; carpus medium, hind lobe slender, apex with single spine, extending slightly beyond palm. Gnathopod 2, basis slender, hind margin with single long setae; propod slender, about 6X maximum depth, lower margin weakly concave, sparsely setose; dactyl short, length ~ 1/6 propod.

Coxa 4 strongly broadened, hind corner acute, not strongly produced. Peraeopods 3 & 4, distal segments regularly setose; segment 6 short, length little greater than depth; dactyl minute. Coxa 5 broad, medium deep, weakly postero-lobate, hind lobe nearly bare below. Coxa 6, antero-distal lobe strong, deep apex sharply rounded. Peraeopods 5 & 6, bases subsimilar, 6 much the larger; dactyls medium short. Peraeopod 7, basis proximally very broadened, narrowing distally to shallow postero-distal lobe, hind margin nearly straight, inner face lacking antero-proximal arc of spines, distally with 2-3 submarginal plumose setae.

Pleon side plate 2, hind corner acute, not produced; plate 3 rounded behind. Uropods 1 & 2, rami extending beyond uropod 3, outer ramus of 2 slightly the shorter. Uropod 3, rami subequal, inner ramus with 2, and outer ramus with 1, marginal spines.

Telson medium narrowing distally, apical margin rounded, penicillate setae distal.

Coxal gills narrowly sac-like. Brood plates relatively short, apices with 6-8 setae.

Mature male unknown.

Etymology: From the Latin "variabilus" - varied, with reference to the variable taxonomic characters, especially of the coxal plates and gnathopod 1 exhibited within the few populations of this study series.

Distributional Ecology. From northern British Columbia to Washington state, subtidally in fine sand to depths of 70 m.

Taxonomic commentary. *Americhelidium variabilum* is most closely related to the advanced North American Pacific endemic *A. pectinatum* and *A. micropleon* (Fig. 42, p. 142). Some morphological variation was noted. In material from Pilot Cove, B. C., the carpal lobe of gnathopod 1 extends well past the palmar postero-distal angle but the postero-distal process of coxa 4 is scarcely at all produced. In gnathopod 1 of material from Neah Bay, the coxa has 3 posterior marginal spines, the propodal palm is more oblique, but the carpal lobe less elongate.

Americhelidium shoemakeri (Mills)
(Fig. 37)

Synchelidium shoemakeri Mills 1962: 15, fig. 4.—Barnard, 1969b:195.—Barnard, 1975: 363, fig. 136.—Austin, 1985: 591.—Staude, 1987: 378.—Barnard & Karaman, 1991: 566.

Material Examined:
ALASKA:
Aleutian Islands. Unimak I., P. Slattery Stns., C40, C42 C112, C115 - 8 specimens, including female (4.0 mm).
Alaska mainland. P. Slattery Stn., 30 miles west of Cape

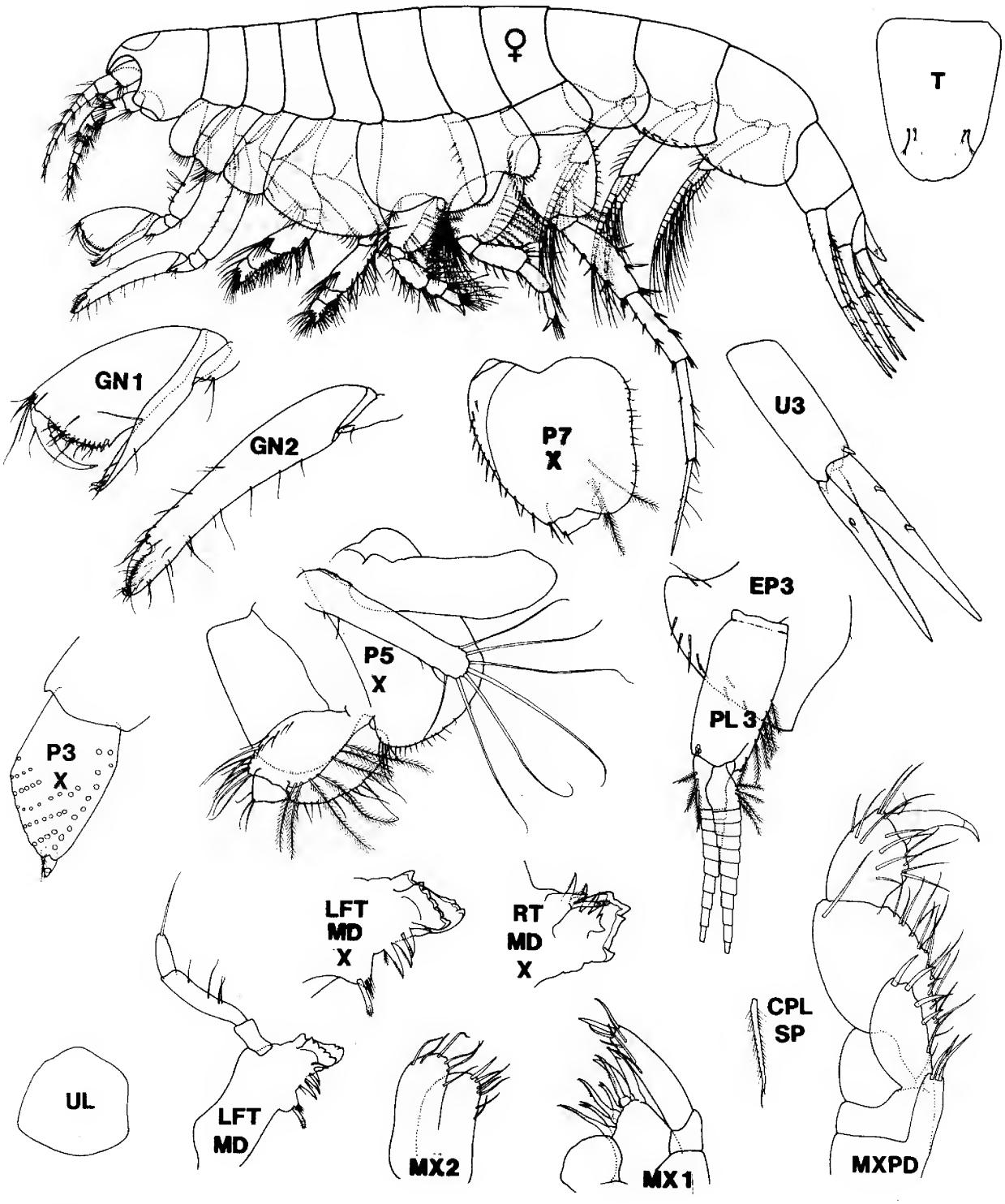

FIG. 36. ***Americhelidium variabilum*****, new species. Neah Bay, Washington. Female ov. (3.0 mm)**

Rodney, Dive 5, 1981 - 1 male, 1 female, 3 immatures.
Southeastern Alaska. ELB Stns., July-Aug., 1961: A42, A175 - 5 females in 2 size classes.
ELB Stns., July, 1980: S1F2, S5B3, S8B1, S11B4, S18B3, S18F1, S18F2, S18 F2 - 47 males, females and immatures.

BRITISH COLUMBIA:
Queen Charlotte Islands. ELB Stn. W9 (Gudal Bay), July 26, 1957 - 1 female.
North-central mainland coast. ELB Stns., July, 1964: H7, H10, H13, H22, H23, H48, H50, H53, H57 - 240 males, females, and immatures.
Vancouver Island, north end. ELB Stns., July, 1959: V3, V7, V22, V17, O5, O7a, O7b, O13 - 30 specimens (incl. male and female holotype and paratype specimens of Mills, 1962).
Vancouver Island, south end. ELB Stns, July-August, 1955:

F1, F3, F5 - 17 specimens.
ELB Stns.,1964: H43 (Witty's lagoon), sand at LW, July 28 - 529 females, 32 males, 11 immatures, including female (4.5 mm) and male (2.4 mm) (**fig'd specimens**), CMN cat. no. NMCC1991-0965; H44 (Brady's Beach), fine white sand at LW, July 29 - 12 specimens.
ELB Stns., July, 1970: P703, P708, P710, P716, P717, P715 - ~350 specimens.
ELB Stns., July, 1975: P14a, P29b, P29c - 26 specimens.
ELB Stns., June, 1976: B4, B27 - 43 specimens.
ELB Stns., May, 1977: B1, B5b, B6b, B8, B13, B14 - 196 specimens (specimens at B14 photographed).
K E Conlan Stns., Saanich Inlet, 1975: 7 stations near Mill Bay - 21 specimens.

WASHINGTON:
ELB Stns., July, 1966: W2, W7, W8, W20, W31, W33, W36, W39, W42 - ~200 males, females, immatures, including small variety at Stn. W8.

OREGON:
ELB Stns., August, 1966: W63, W64 - 3 specimens.
CMN collections, Ottawa.

Diagnosis: Female ov. (3.5 - 4.5 mm). Head, rostrum short, deflexed. Fused eyes large, fully on rostrum. Antenna medium, flagella 5-6-segmented.

Mandible, molar with 2 very unequal apical spines; spine row with 4 regular blades, right lacinia small; spine-like; left lacinia irregularly 5-7 dentate; palp segment 3 short, weakly long-setose, length ~1/2 segment 2. Maxilla 1, outer plate, apical spines slender, tips level with apex of palp. Maxilla 2, inner plate distally narrowing, apex strongly setose. Maxilliped, inner plate with 2 apical setae; outer plate short, not reaching half way along medium stout palp segment 2.

Coxa 1, not broadened hind margin with 2-3 spines, lower margin weakly setose. Coxa 2 narrow, hind margin with 5-6 unequal spines. Gnathopod 1, basis antero-distally nearly bare of setae; propod strong, relatively slender; palm regularly oblique, virtually smooth, carpus narrow, hind lobe slender, apex with single spine, extending slightly beyond palm. Gnathopod 2, basis slender, hind margin with 1-2 long setae; propod medium, length 5-6 X maximum depth; dactyl medium, length ~ 1/5 propod.

Coxa 4 strongly broadened distally, hind corner acute, strongly produced, upturned apically. Peraeopods 3 & 4, distal segments regularly setose; segment 6 short, narrowing distally, dactyl minute. Coxa 5 very large, as deep as coxa 4, slightly posterolobate, hind lobe nearly bare below. Coxa 6, antero-distal lobe medium strong, apex regularly rounded. Peraeopods 5 & 6, bases subsimilar, 6 the larger; with stronger postero-proximal lobe; dactyls short. Peraeopod 7, basis broad, hind margin convex, postero-distal lobe medium, barely reaching distal margin of ischium; inner facial row of 4-5 plumose setae.

Pleon side plate 2, hind corner acute, produced; plate 3, hind corner obtuse. Uropods 1& 3, rami very slightly unequal. Uropod 2, rami relatively long, outer ramus distinctly the shorter; all rami extending equidistant posteriorly. Uropod 3, inner ramus with 42 marginal spines; outer ramus smooth.

Telson narrowing distally, apical margin regularly rounded, penicillate setae distal.

Coxal gills relatively short, sac-like. Brood plate on peraeopod 5 with 10 long apical setae.

Male (2.4 - 3.5 mm). Antenna 1, peduncular segments 2 & 3 shorter and less setose than in female; basal flagellum 7-8 segmented, basally callynophorate but not fused, bearing numerous aesthetascs. Antenna 2, peduncular segments 4 & 5 short, lacking anterior marginal brush setae; flagellum very elongate, with 50-60 segments.

Mandibular palp segment 3, length 3/4 segment 2, inner margin with regular pectinate "D" setae.

Distributional ecology: From Unimak I, and south-eastern Alaska, through British Columbia, Washington and Oregon to the central California coast, on sandand fine sand bottoms, from the shoreline subtidally to about 70 m.

Taxonomic Commentary. *Americhelidium shoemakeri* is the most common species on the Pacific coast of North America. It is not closely related to any species but is least different from *A. millsi* (Fig. 42, p. 142).

This species varies considerably, in morphology and size at maturity, throughout is geographical and bathymetrical range. The degree of variation was not considered of species significance in this investigation, but further study may indicate otherwise.

Americhelidium millsi, new species
(Fig. 38)

Material Examined.
WASHINGTON
ELB Stns., July, 1966: W33 (Crescent Beach) - 1 male (4.2 mm), 4 females ov., NMCC1991-0991; W35 (Agate Beach) muddy sand at LW - 1 female, NMCC1991-0356; W39 (Neah Bay, at east boat slip), medium coarse sand, muddy sand at LW level, July 30 - female ov (5.5 mm) **Holotype**; male (4.2 mm) **Allotype**; 1 male **Paratype**; CMN cat no. NMCC1991-0094.

Diagnosis. Female ov. (5.5 mm). Head, rostrum medium, deflexed. Fused eyes medium, fully on rostrum. Antenna medium, flagella 5-8 segmented.

Mandible, molar with 2 unequal apical spines; spine row with 2-3 regular blades; right lacinia narrowly bifid; palp segment 3 medium, apex and inner margin with long setose, length ~2/3 segment 2. Maxilla 1, outer plate, apical spines ordinary, not exceeding distally narrowing palp. Maxilla 2, , outer plate narrow, apically 6-7 setose. Maxilliped, inner plate with 3-4 apical setae; outer plate short, not attaining

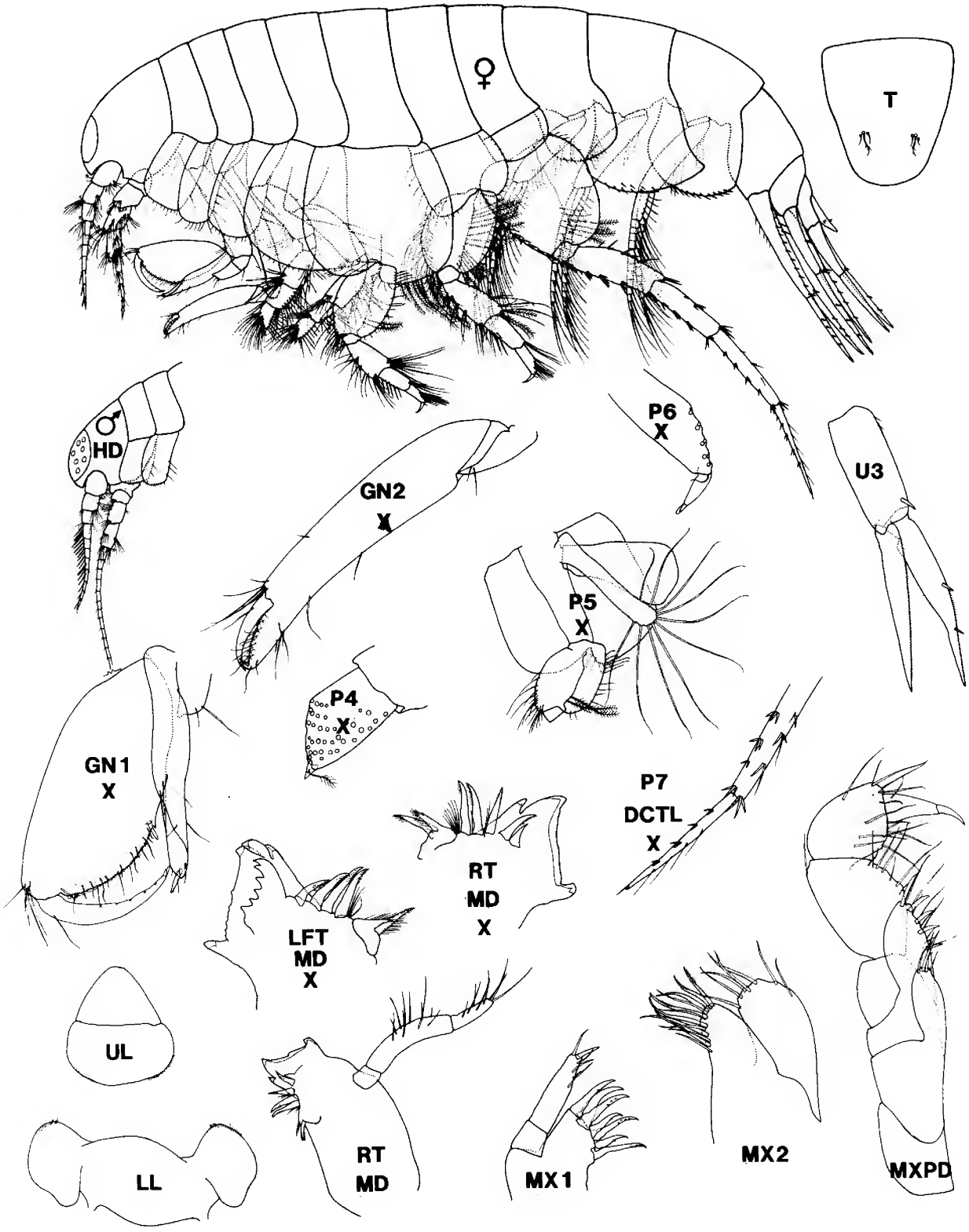

FIG. 37. ***Americhelidium shoemakeri*** **(Mills). Witty's Lagoon, Vancouver I., B. C. Female (4.5 mm); male (2.4 mm).**

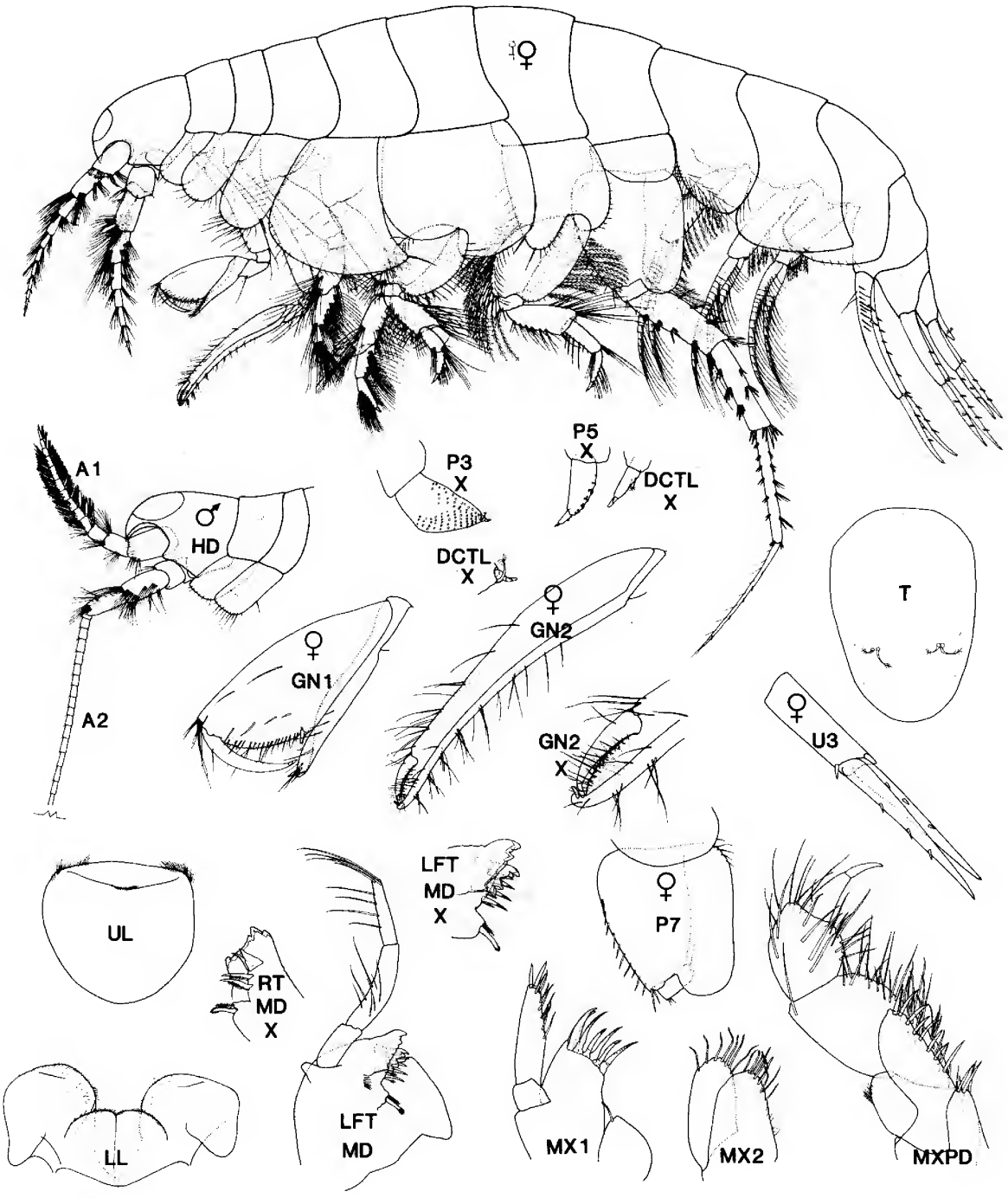

FIG. 38. Americhelidium millsi, new species. Neah Bay, Washington. Female (5.5 mm); male (4.2 mm).

half way point of stout palp segment 2.

Coxa 1, relatively narrow, hind corner broadly rounded, hind margin with 1-2 spines, lower margin weakly setose. Coxa 2, hind margin with single spine. Gnathopod 1, basis with strong antero-medial cluster of medium setae, and several long postero-median setae; propod slender, narrow proximally, palm nearly smooth regularly oblique; carpus narrow, hind lobe slender, apex with single spine, extending beyond palm. Gnathopod 2, basis very slender, hind margin with 1-2 long setae; propod very elongate, slender, antero-distally setose, length 7-8X maximum depth; dactyl small, length ~10% propod; carpus very narrow, posterior guarding lobe fused to but finely demarcated from propod throughout its length. and relatively strongly setose posteriorly.

Coxa 4 strongly broadened distally, hind corner acute, strongly produced. Peraeopods 3 & 4, distal segments very strongly setose; segment 6 very short, length little greater than depth, dactyl minute. Coxa 5 very broad, nearly as deep as coxa 4, distinctly postero-lobate, hind lobe weakly setose below. Coxa 6, antero-distal lobe strong, regularly rounded below. Peraeopods 5 & 6, bases subsimilar, 6 the larger; dactyls medium; basis of 6 very strongly plumose-setose anteriorly. Peraeopod 7, basis slightly narrowing to large deep postero-distal lobe; inner face with short antero-proximal setal row, and distal submarginal row of 5-6 long plumose setae.

Pleon side plate 2, hind corner acute, produced; plate 3, hind corner obtuse Uropod, rami extending beyond uropods 1 & 3, outer ramus the shorter. Uropod 3, rami subequal in length each with 3 marginal spines.

Telson relatively broad, narrowing to rounded apex, penicillate setae submedian.

Coxal gills and brood plates regular.

Male (3.5 mm) (diagnosis modified from Mills, 1962). Antenna 1, peduncular seg-ments 2 & 3 shorter than in female; basal flagellar segments not callynophorate, not bearing numerous aesthetascs. Antenna 2, peduncular segments 4 & 5 short, lacking anterior marginal brush setae; flagellum elongate, 40-45 seg-mented.

Mandibular palp segment 3, length 2/3 segment 2, inner margin with regular pectinate "D" setae.

Male (4.2 mm). Antenna 1, peduncular segments 2 & 3 shorter and less setose than in female; flagellum 10-segmented, callynophorate but not fused, margins thickly lines with aesthetascs. Antenna 2, flagellum elongate, 40+ segmented.

Mandibular palp segment 3 regular, posterior margin with pectinate "D" setae.

Etymology: The species is named in honour of Dr. Eric L. Mills, Dalhousie University, who pioneered the study of oedicerotid amphipods in the Canadian Pacific region.

Distributional Ecology. Known only from three locations on the south shore of the Strait of Juan de Fuca, in muddy sand, at LW level.

Taxonomic commentary. *Americhelidium millsi* is the most advanced and most specialized species of the genus, not closely related to any other, but least different from *A. shoemakeri* (Mills, 1962).

Americhelidium micropleon (J. L. Barnard)

Synchelidium micropleon J. L. Barnard, 1977: 877, figs. 1-4.—Barnard & Karaman, 1991: 566.

Diagnosis (after Barnard, 1977). Female (3.37 mm): Head, rostrum short; eyes consisting of weakly pigmented, loosely aggregated ommatidia. Antennae 1 & 2 subequal in length; flagella with 8-9 segments.

Mandible with unequally bispinose molar and 3-4 short stout blades; palp segment 3 very short, ~1/3 segment 2. Maxilliped, inner plate small, apical margin with 2 slender spines; palp segment 3 very stout, width > 2/3 length.

Gnathopod 1, propod relatively short and deep, palm nearly vertical. Gnathopod 2, propod very slender; line of fusion with carpus visible proximally and distally; lower margin weakly setose.

Coxa 4 much broader and deeper than coxa 3, hind process strongly produced. Coxa 5 very large, deep, distinctly postero-lobate. Peraeopods 3 & 4, segments 5 & 6 very short, stout, dactyls vestigial. Peraeopod 6 (especially basis) distinctly larger than peraeopod 5; dactyls very short. Peraeopod 7, basis broad, narrowing distally to deep posterior lobe; dactyl slender, tapering, length > segment 6.

Pleon plate 2, hind corner squarish. Uropods 1 & 2, outer ramus the shorter, rami extending well beyond rami of short uropod 3. Telson narrowing distally, apex rounded.

Male (2.39 mm). Antenna 1, flagellum with 5 slender aesthetascs on proximal 5-6 segments. Antenna 2, flagellum not elongate. Mature male may be non-pelagic.

Taxonomic and distributional commentary. This small species occurs only along open sandy beaches of the southern California coast. It exhibits generally apomorphic character states that typify the *pectinatus* subgroup within the genus *Americhelidium* (fig. 42, p. 142). Such apomorphies include the thick mandibular blades, short maxillipedal outer plate, elongate propod of gnathopod 2, posteriorly unproduced pleon plates 2 & 3, short uropod 3, and sharply rounded telson.

DISCUSSION AND CONCLUSIONS.

This study treats the systematics and distributional ecology of oedicerotid amphipods of the *Monoculodes* and *Synchelidium* supergroups in the North Pacific region. These encompass nearly 50 described species in 15 genera. The foregoing illustrated diagnoses have revealed morphological similarities between taxa that, as a result of numerical taxonomic analysis (below), are of probable phyletic significance.

For this purpose, the character states of genera and species are phyletically ordered and analyzed, using a modification of the UPGMA system of Sneath and Sokal, (1973) that employs an index of morphological similarity termed the Plesio-Apomorphic (P.-A.) Index. This modification has been utilized in previous development of natural relationships and classifications in other amphipod groups, e.g., in Conlan (1983); Jarrett & Bousfield (1994); Bousfield and Hendrycks (1995). The degree of primitive or advanced condition of the taxon is direction proportional to the magnitude of the P.- A. Index; taxa with low numbers are primitive, those with relatively higher numbers are advanced.

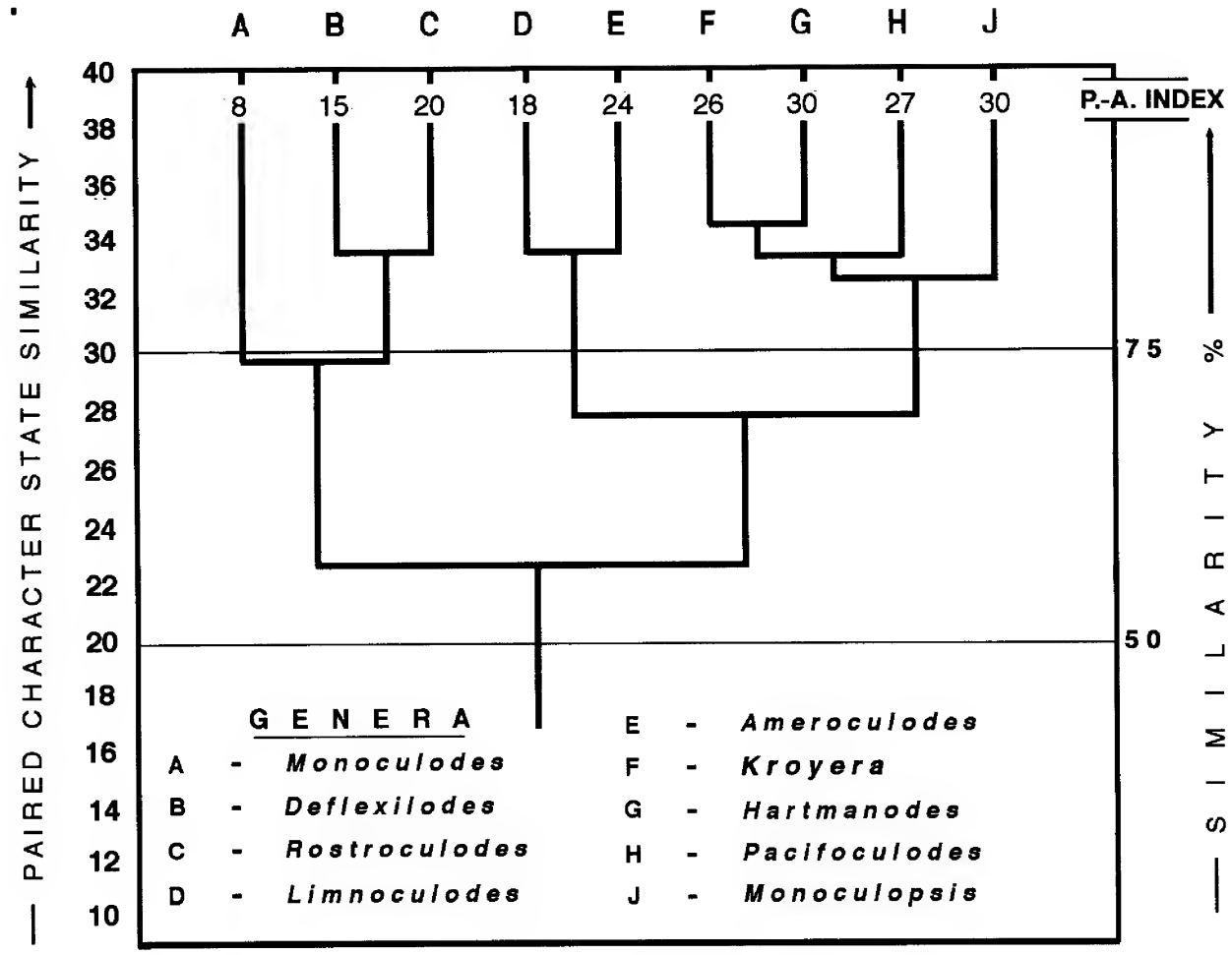

FIG. 39. PHENOGRAM: GENERA OF THE *MONOCULODES* GROUP.

Phenograms of taxonomic groups are developed from matrices of 16-20 characters and corresponding character state extremes. A phenogram of morphical similarities for genera of the *Moncolulodes* group is provided in Figure 39, based on the characters states of Table I. Similarly, phenograms for species of North Pacific species of *Monoculodes* Stimpson (sens. str.), *Pacifoculodes*, new genus, and species of the *Americhelidium* group, are provided in figs. 40-42, respectively. Tabular data, on which the latter phenograms were based, are considered overly bulky and repetitive for publication here, but can be supplied on request.

Of the 9 monoculodid genera analyzed in Fig. 39, some (e.g., *Monoculodes, Deflexilodes*) are speciose, with broad distribution elsewhere in the northern hemisphere. Others *(Monoculopsis, Limnoculodes, Hartmanodes, Rostroculodes*) are virtually monotypic and/or have very narrowly limited regional distributions. In Fig. 39, three basic subgroups within the *Monoculodes* complex cluster at at or above the 75% similarity level, viz.:

(1) a *Monoculodes-Deflexilodes, Rostroculodes* subgroup with P.-A. indices of 8 - 20 and having generally plesiomorphic characters states (Fig. 1, p. 79, and Table I). Component species tend to be sublittoral to bathyal, and best represented in the colder arctic and northern oceans (Table II, below).

(2) a *Limnoculodes-Ameroculodes* subgroup, having intermediate character states (Fig. 1) and intermediate P.- A. values of 18-24. Member species tend to occupy shallow, littoral and estuarine habitats along warm-temperate shores of eastern Asia and eastern North America (Table II).

(3) a *Pacifoculodes* subgroup having generally advanced character states (Fig. 1) and relatively high P. - A. values of 27-30. The group encompasses the small, warm temperate-tropical genus *Hartmanodes*, and the monotypic, amphiboreal genus *Kroyera*, on the one hand, and the nearly monotypic, high arctic genus *Monoculopsis* on the other. The latter vies with advanced members of *Pacifoculodes* (e.g., *A. millsi*) in exhibiting the most apomorphic features of mouthparts and appendages, especially the peraeopods, and gnathopods. Thus, the degree of fusion of the carpal lobe and the elongation and distal narrowing of the propod approaches the condition in more primitive members of the *Synchelidium* complex (e.g., *Hongkongvena*, below). Evolutionary thrust in this group is apparently towards utilizing food resources of high energy substrata of shallow sandy shores, where powerful, strongly setose limb segments would not only assist in burrowing within rapidly shifting substrata, but would

TABLE I. CHARACTERS AND CHARACTER STATES OF THE *MONOCULODES* COMPLEX .

CHARACTER*	CHARACTER STATE VALUE		
	Plesiomorphic 0	**Intermediate 1**	**Advanced 2**
1. Rostrum, form	straight	Apically deflexed	Elongate, eye distal
2. Antenna 1 peduncular segment 2, length rel. to pedunc. segment 1	shorter	subequal	longer
3. Mandibular palp segment 3, length relative to segment 2	subequal	shorter	much shorter
4. MX1, number outer plate spines	9	8	7
5. MXPD, width of palp segment 2	narrow	medium	broad
6. *Gnathopod 1, carpus, length of anterior margin	elongate	medium	narrow
7. *Gnathopod 1, carpus, length of posterior lobe	small, 1/2 propod hind margin	medium	large reaching palmar angle
8. *Gnathopod 1, propod shape	short, deep	medium	elongate
9. *Gnathopod 2, carpus, length of anterior margin	elongate (> depth)	medium	narrow
10.*Gnathopod 2, carpus, length of posterior lobe	short, < 1/2 propod	medium	elongate, exceeding posterior palmar angle
11. *Gnathopod 2, propod shape	short, deep	medium (L>W)	elongate, tapering
12. Coxa 4, breadth	narrow, deeper than wide	width = depth	broad , much wider than deep
13. *Peraeopods 3 & 4, length of segment 5 rel. to segment 6	5 >6	segments subequal	short; seg 5<6
14. *Peraeopods 3 & 4, length of dactyls	elongate >segment 6	medium	short, <1/2 segment 6
15. Peraeopods 5 & 6, length of segment 5/ segment 6	segment 5>>6	segments subequal	short, segment 5 < 6
16. Peraeopods 5 & 6, length os dactyls	elongate, >segment 6	medium	short, segment 5 < 6
17. *Peraeopod 7, basis, size of posterior (lower) lobe	small or lacking	medium	large, exteding below segment 3 (ischium)
18. Pleon plate 2, hind corner	acute, produced	squared	obtuse, rounded
19. Uropods 1 & 2, rami	subequal	outer ramus slightly the shorter	outer ramus distinctly the shorter
20. Telson, apical margin	notched	straight	rounded

* Character states illustrated in Fig. 1, p. 79

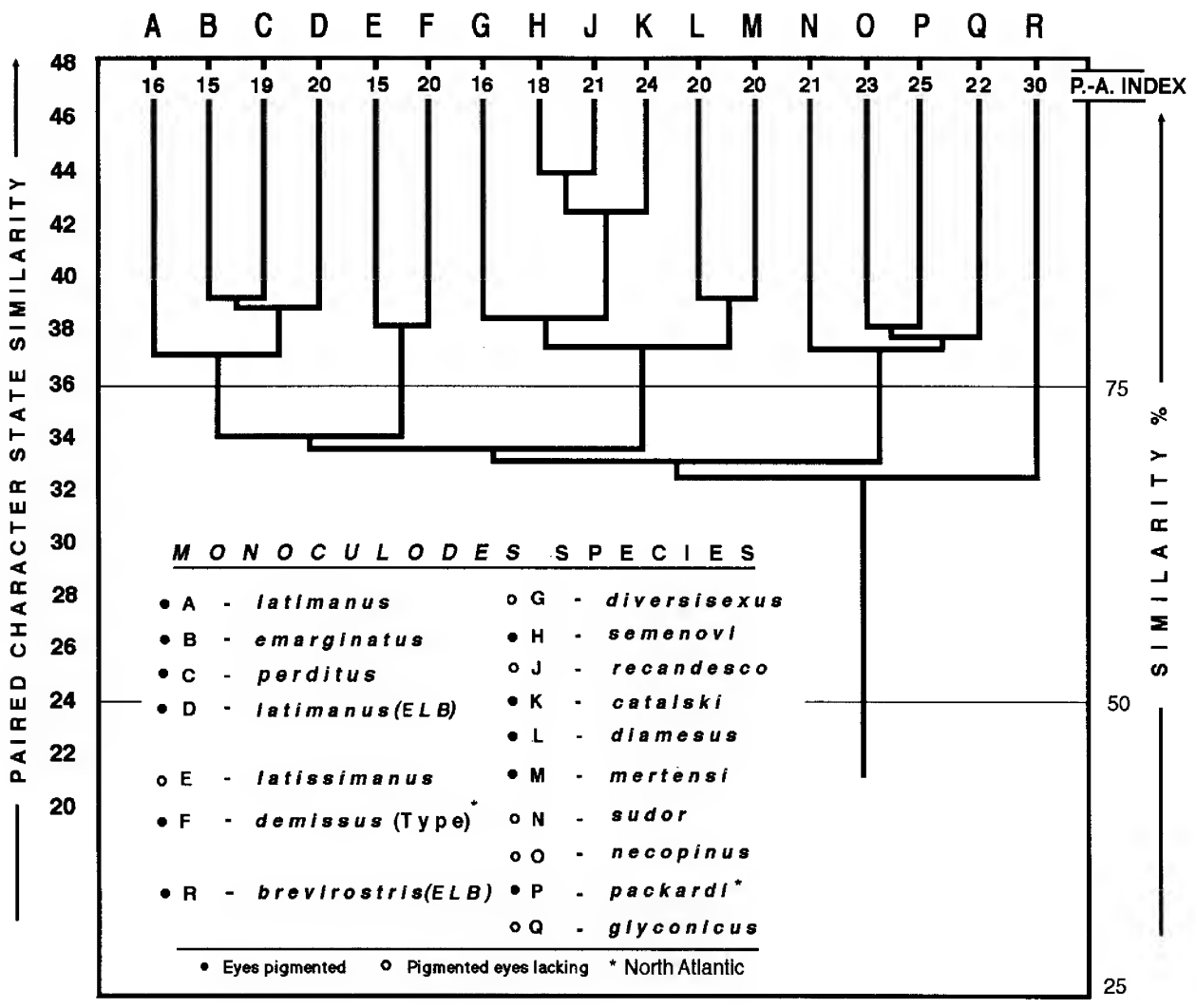

FIG. 40. PHENOGRAM: NORTH PACIFIC SPECIES OF *MONOCULODES*.

presumably help maintain the integrity of the ventral repiratory passage, despite pressure from infiltrating fine sediments (see Enequist, 1949).

The 15 species of *Monoculodes* Stimpson (sens. str.) recorded to date from the North Pacific region are all sublittoral (mostly eyed) and bathyal (eyeless). The phenogram (Fig. 40) is based on characters and character states similar to those of Fig. 39.

The species cluster into 5 major groups at about the 70% similarity level, viz.:

(1) A primitive, sublittoral, mostly North American *latimanus-emarginatus* subgroup of 3 species. These mainly eyed species display basic plesiomorphic characters states, especially of the gnathopods, and have relative low P. - A. values of 16-20.

(2) A bathyal *M. latissimanus* subgroup, widespread in holarctic seas, that bears closest similarity to the sublittoral generic type species, *M. demissus* of the boreal-subarctic North American Atlantic region.

(3) A slightly more advanced *semenovi-recandesco* subgroup of six ,mostly eyed,sublittoral and bathyal species, that occur on both coasts, and show intermediate P.-A. values of 18 - 24. The species are characterized by a short rostrum and broad anterior head lobe.

(4) An advanced *necopinus* subgroup of three eyeless, bathyal North American Pacific species, with greater than 75% similarity to the eyed sublittoral North Atlantic species, *M. packardi* Boeck. These exhibit relatively advanced features of the gnathopods and show relatively high P.- A. values of 21-25.

(5) A monotypic, North American endemic *brevirostris* subgroup that is least different from the short-rostrate, second subgroup of species (especially *M. catalskii*). It shows mainly advanced character states (high P.A. index of 30), including an elongate antenna 1 and well-developed fossorial peraeopods.

Of these 15 species, 13 are regionally endemic and only two (*M. latimanus* and *M. latissimanus*) have been recorded

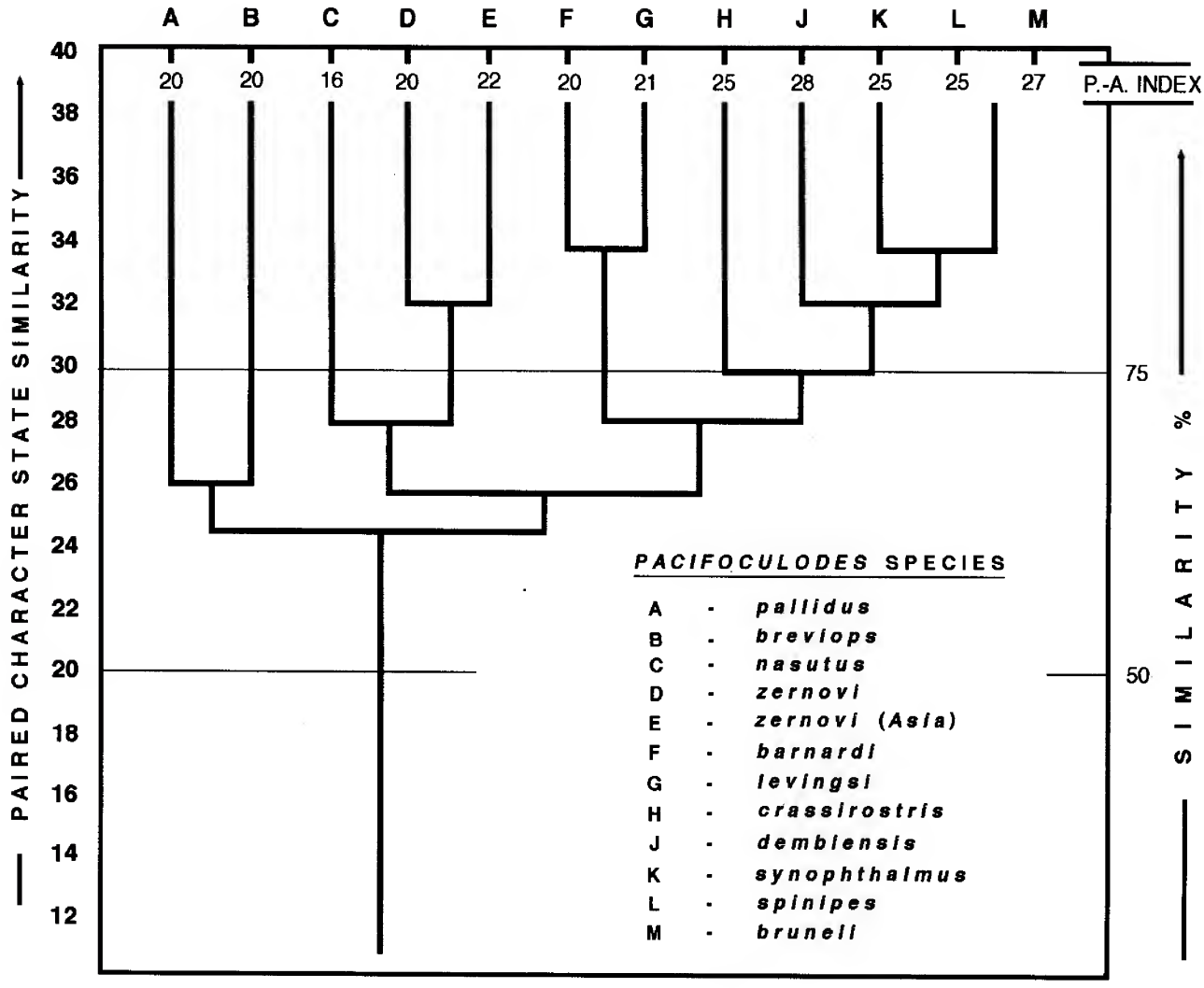

FIG. 41. PHENOGRAM: SPECIES OF *PACIFOCULODES*, NEW GENUS.

elsewhere. High regional endemicity is not unexpected in fossorial species, especially cold-temperate stenothermals, that may be limited to the north and south by polar and subtropical temperate extremes respectively.

The North Pacific is home to all 12 described species of *Pacifoculodes*. The phenogram (Fig. 41) is based on character states similar to those of Table I, the data base for which is available on request.

The species cluster into three main groups at or above the 60% similarity level, viz.:

(1) A *pallidus-breviops* subgroup of relatively small, primitive forms confined to the northwestern Pacific region. These exhibit mainly plesiomorphic character states, especially of the gnathopods, and show a low P.- A. value of 20.

(2) A *zernovi-nasutus* subgroup of three relatively primitive species having P.- A. indices of 16-22. They have relatively long, straight rostrums and shallow basal lobes on peraeopod 7. *P. zernovi* is the only pan-Pacific member of the genus.

(3) A more advanced *barnardi-spinipes* subgroup that shows P.-A. values of 21-28. The animals are relatively large, with powerfully developed fossorial appendages. This cluster subdivides at the 75% similarity level into two further groups. Thus, a a relatively primitive *barnardi-levingsi* subgroup is endemic to subtidal coastal habitats of the North American coast. A more advanced and more northerly, mainly shallow-subtidal subgroup contains 4 species, two of which (*P. dembiensis* and *P. synophthalmus*) are Asiatic-Pacific, and the two closely related (sibling) species (*P. spinipes* and *P. bruneli)* are North American endemic.

The previous record of the European-Atlantic species, *P. crassirostris* from the Sea of Japan (Gurjanova, 1951), has been demonstrated by Ledoyer (1972) to be almost certainly that of a different, unnamed species. Similarly, the record of *P. pallidus* from the Sea of Japan (Gurjanova, 1951) has not yet been confirmed, and may also prove to be a further undescribed species of the genus. In any event, both

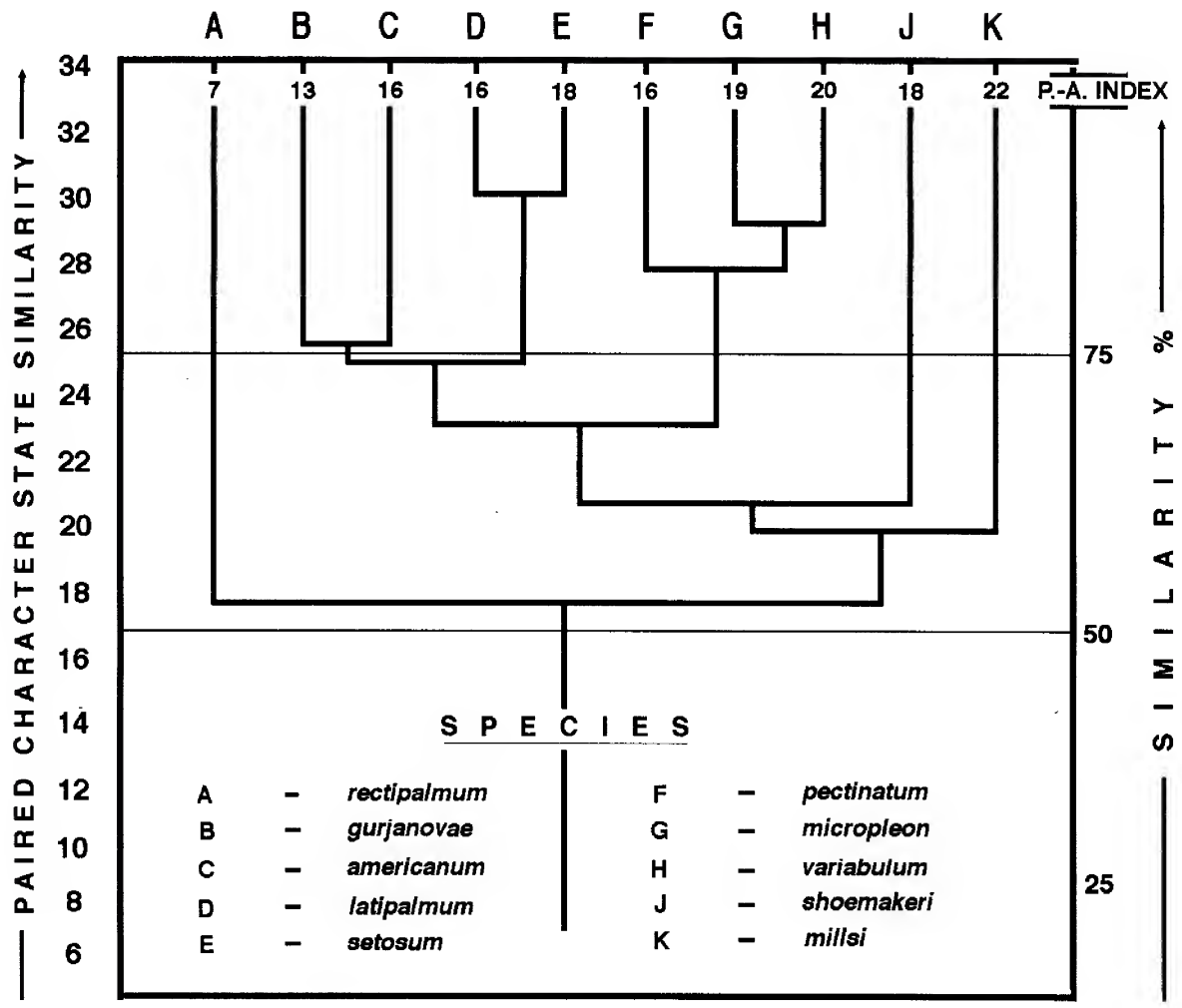

FIG. 42. PHENOGRAM: SPECIES OF *AMERICHELIDIUM*.

crassirostris and *pallidus*, as described and figured by Sars (1895), conform most closely with the character states of the genus *Pacifoculodes*.

A phenogram of the 10 described species of *Americhelidum* (Fig. 42) is based on slightly fewer and different characters and character states than listed in Table I; some have been diagnosed in generic treatments peculiar to the *Synchelidium* complex (above).

In the present analysis, five subgroups cluster at or better than the 60% similarity level, viz.:

(1) A monotypic *rectipalmum* subgroup that shows very plesiomorphic character states and a low P.- A. index of 7. This North American Pacific endemic is remote from all other species at about the 50% level, and might justify separate subgeneric, if not full generic recognition.

(2) A *setosum* subgroup, of relatively primitive species, clusters at or above the 75% similarity level, and shows intermediate P.-A.values of 3 -18. Despite their close internal clustering, the subgroup is surprisingly disparate biogeographically. Thus, it encompasses 2 Asiatic-Pacific endemics, a North American-Pacific endemic, and the single known American-Atlantic species, *A. americanum*.

(3) A relatively advanced *micropleon* subgroup (P.- A. values of 16-20) of closely similar species. They cluster at and 80-85% similarity and show high P.- A. values of 19-20. All members are North American endemic.

(4) A monotypic *shoemakeri* subgroup consisting of a single species that is morphologically variable throughout its broad North American range. It shows a medium P.- A. value of 18, but is isolated from the other groups at the 60% similarity level. Further study may reveal this "super" species to be a complex of closely related (sibling) species, much as Mills (1967) discovered during his careful investigations on *"Ampelisca spinipes"* on the North American Atlantic coast.

(5). A *millsi* subgroup, containing the single most advanced and specialized species, shows a high P. -A. Index of 22. This distinctive taxon is isolated from the other four subgroups at the 60% similarity level. The species is a North American Pacific endemic, with a restricted local range (p. 145). Its specialized, even unique, morphological features suggest that it may be adapted to burrowing in fine silty sands, at and below tide levels, possibly under reduced levels of free oxygen but relatively high levels of reduction gases.

TABLE II. DISTRIBUTION OF SPECIES OF *MONOCULODES* SENS. LAT. IN NORTH PACIFIC*

TAXON	BIOGEOGRAPHIC ZONES								
	1	2	3	4	5	6	7	8	9
I. *Monoculodes* Stimpson									
packardi Boeck	X	x							
semenovi Gurjanova	X	?							
latimanus Boeck	X	X	X	X	X	X			
mertensi Gurjanova		?	X						
castalski Gurjanova		X	X						
diamesus Gurjanova		X			?	X			
perditus Barnard				?	X	X		x?	X
brevirostris n. sp.					?	X			
latissimanus Stephens.							X	X	X
recandesco Barnard							X		X
emarginatus Barnard							X	X	X
sudor Barnard									X
necopinus Barnard								?	X
glyconicus Barnard								?	X
diversisexus Barnard									X
II. *Deflexilodes* n. g.									
uncinatus (Bulycheva)	X	?							
similis n. sp.			X	?	X	X			
enigmaticus n. sp.				X	X	X			
tuberculatus Boeck				X					X
norvegicus (Boeck)									X
III. *Kroyera* Bate									
carinata Bate	X								
IV. *Monoculopsis* Sars									
longicornis (Boeck)		?	X						
V. *Pacifoculodes* n. g.									
pallidus (Sars)	X								
synophthalmus (Bul.)	X	?							
nasutus (Bulycheva)	X	?							
breviops (Bulycheva)	X	?							
dembiensis (Bul.)	X	X							
crassirostris (Hansen)?	X	X	X						
zernovi (Gurjanova)	X	X	X	X	X	X			
bruneli n. sp.			x?	X					
levingsi n. sp.					X				
spinipes (Mills)					X	X	X	?	
VI. *Hartmanodes* n. g.									
murrius (Barnard)									X
hartmanae (Barnard)								X	X
nyei (Shoemaker)									X

BIOGEOGRAPHIC ZONES: 1. Sea of Japan; 2. Sea of Okhotsk; 3. Bering Sea & Aleutians; Southeastern Alaska; 5. Northern B. C.; 6. Southern B. C.; 7. Washington-Oregon; 8. Northern California; 9. So. & Baja California.

*exclusive of *M. dentimanus* Jo, 1990, *M. muwoni* Jo, 1990, and *M. koreanus* Jo, 1990.

TABLE III. DISTRIBUTION OF THE *SYNCHELIDIUM* COMPLEX IN THE NORTH PACIFIC.

TAXON	BIOGEOGRAPHIC ZONES								
	1	2	3	4	5	6	7	8	9
1. *Perioculodes* Sars									
longimanus (B.&W.)	X								
longirostratus Hiray	X								
pinguis Hirayama	X								
2. *Pontocrates* Boeck									
altamarinus (B.&W.)	X								
arenarius (Bate)	X								
3. *Hongkongvena* Hiray									
memorabilis Hiray.	X								
4. *Sinoediceros* Shen									
homopalmatus Shen	X								
5. *Eochelidium* n. g.									
bulytschevae (K.&T.)	X								
carinorostrum (Jo)	X								
rostriopiculum (Hir.)	X								
lenorostralum (Hir.)	X								
nonrostrum (Hir.)	X								
nonmiraculum (Hir.)	X								
miraculum (Imbach)	X								
6. *Chitinomandibulum*									
emargicoxa Jo	X								
ampliforbicum (Hir.)	X								
7. *Finoculodes* Barnard									
omnifera Barnard							X		
8. *Americhelidium* n. g.									
latipalpum (Hiray.)	X								
gurjanovae (K. & T.)	X								
rectipalmum (Mills)			x	X	X	X	X	x?	
setosum n. sp.				X	X				
variabilum n. sp.					X	X	X		
millsi n. sp.						x?	X		
pectinatum, n. sp.						X	X	X	
shoemakeri (Mills)			x	X	X	X	X		
micropleon (Barnard)								x	X

BIOGEOGRAPHIC ZONES

1. Sea of Japan; 2. Sea of Okhotsk; 3. Bering Sea & Aleutians; Solutheastern Alaska; 5. Northern B. C.; 6. Southern B. C.; 7. Washington-Oregon; 8. Northern California; 9. Southern & Baja California.

Biogeographic Analyses:

Table II. outlines the distribution of the 6 genera and 37 North Pacific species within the *Monoculodes* complex. North Pacific records of *Kroyera carinata* Bate, though doubtful, are included here. These totals represent more than two-thirds of the entire world monoculodid fauna. Only the polar regionally endemic genus *Rostroculodes* (6 species), and the North American Atlantic genus *Ameroculodes* (2+ species) are apparently absent from the North Pacific proper.

Within the North Pacific monoculodid fauna, all six genera and 29 of the species have been recorded from North American coastal waters whereas only 5 genera and 16 species are known from the western North Pacific. Only 7 species in 4 genera occur along both coasts, almost all in the Bering Sea region. The western region contains only one described species of the primitive, mainly North Atlantic genus *Deflexilodes*, and none of the relatively advanced neotropical genus *Hartmanodes*. However, the western region is dominated by the advanced, largely intertidal and shallow water genus *Pacifoculodes* , with 7 species, whereas the the North American region has only 4 species.

In further contrast, the eastern North Pacific also has a higher percentage of the primitive subtidal and bathyal genus *Monoculodes* (13 species vs. 6 species), as well as four mainly subtidal species of the primitive genus *Deflexilodes*. The three shallow-water species of *Hartmanodes*, of southern and Baja California (zone 9), find no counterpart in the western Pacific, unless these be members of the *Synchelidium* generic complex (below).

Table III outlines the distribution of the 8 genera and 26 described North Pacific species within the *Synchelidium* complex. As noted above, these numbers represent a very high percentage of the total world fauna known to date. Except for the 5 members of the genus *Synchelidium*, and one of *Americhelidum* from the western North Atlantic, the group is known elsewhere only in the eastern North Atlantic and Mediterranean region (e.g, species of *Perioculodes*).

The western North Pacific has the greatest diversity of synchelidiid genera and species. Five of its seven genera, and nearly all of its 18 species are regionally endemic. Two of these genera (*Perioculodes* and *Pontocrates*) are recorded elsewhere, mainly from the eastern North Atlantic. By contrast, the eastern North Pacific is home to only two genera and 8 species, only one genus of which (*Finoculodes*) is endemic. However, the advanced genus *Americhelidium* is dominant on the North American coast, but barely represented on the Asiatic coast.

On the Asiatic coast, all species and genera of the *Synchelidium* complex are limited distributionally in the northern Sea of Japan. On the North American Pacific coast, varieties of the most primitive species of *Americhelidum*, *A. rectipalmum* (Mills), extend northward to the Bering Sea region. This species also has the deepest bathymetrical range within the genus, suggesting a cold-adapted physiology. By contrast, one of the most advanced species morphologically, *A. micropleon*, also has the most southerly range and is strictly intertidal and shallow water in bathymetrical range.

Analysis of the genus *Americhelidium*, in which both primitive and advanced members are regionally endemic, suggests strongly that the North Pacific is a centre of origin and evolution of the entire group. The fact that the most advanced members are intertidal, shallow water, and to some extent estuarine, and only very few, especially primitive members, are subtidal and bathyal (e.g. *Finoculodes)* strongly suggests that the group has only recently evolved, possibly since the beginning of the Tertiary Era and is now actively in process of speciation. The more advanced members are intertidal and shallow water, perhaps in the process of replacing the primitive members of the group that are now confined to deeper water. Such "evolutionary bathymetry" contrasts strongly with that previously found in more primitive fossorial amphipod superfamily groups of the North Pacific (e.g., Phoxocephaloidea) wherein the more primitive members are intertidal, and the advanced members subtidal (Jarrett & Bousfield, 1994).

The high degree of variability observed throughout the range of North American Pacific species, would tend to support such speculation. Thus, eastern and western shores of the North Pacific share some genera and a few species, but overall, these two regions exhibit a remarkable and somewhat puzzlingly difference of oedicerotid faunas. North American shores exhibit a far richer assemblage of primitive monoculodids whereas Asiatic Pacific waters support a broad spectrum of the advanced synchelidids, at both genus and species levels. Perhaps paradoxically, the most advanced monoculodid genus, *Pacifoculodes,* is more diverse in the western Pacific, but the most advanced synchelidid genus, *Americhelidum*, is richer in species along North American shores. Further study of life style and reproductive behaviour may help solve this apparent conundrum.

LEGEND FOR FIGURES

A1	-	antenna 1	I. P.	-	inner plate	PLP	-	palp
A2	-	antenna 2	LL	-	lower lip	PLEON	-	pleon
CX	-	coxa	LFT	-	left	RT	-	right
DCTL	-	dactyl	MD	-	mandible	T	-	telson
DORS	-	dorsal	MX	-	maxilla	U1-3	-	uropods 1-3
EP1-3	-	epimeral plates 1-	MXPD	-	maxilliped	UL	-	upper lip
GN1	-	gnathopod 1	O. P.	-	outer plate	UROS	-	urosome
GN2	-	gnathopod 2	P1-7	-	peraeopods 1-7	T	-	telson
HD	-	head	PEN	-	penultimate	X	-	enlarged

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